Course Catalog 2006/2007

Norwegian University of Life Sciences

COURSE CATALOG 2006/2007

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WELCOME TO NEW STUDENTS

Founded in 1859 as the only Norwegian agricultural post-graduate college, the Norwegian University of Life Sciences (UMB) has broadened it's perspectives and is now recognised as a leading international centre of knowledge focused on higher education and research within environmental- and biosciences, as well as development studies, business studies, land use and natural resource management and engineering.

UMB offers an increasing range of Master programmes in English, as well as the Bachelor in Developmental Studies. Whether you wish to study food in production, utilisation, trade or for the benefit of your health or simply want a business degree; there are numerous opportunities at UMB for students who care about sustainable development in the world to obtain valuable knowledge. About 1/3 of our courses are offered in English, also within Norwegian programmes. This means that you are able to choose elective courses also outside the core your own study programme.

I encourage you to study what we have on offer in this pamphlet. I bid you welcome to UMB in case you choose to apply and are chosen to become one of our students.

Happy reading!

Trine Hvoslef-Eide
Prorector for Studies at UMB

STUDYING AT THE NORWEGIAN UNIVERSITY OF LIFE SCIENCES (UMB)

UMB offers a broad range of study programmes that closely correspond with major research issues related to food and environmental sciences, biology, land use and natural resource management. UMB is Norway's leading institution of higher education in its field.

High professional quality, a high degree of teacher-student interaction and a pleasant social and physical environment characterise education at UMB. A broad range of study programmes are offered at the Bachelor's, Master's and PhD level.

About 180 of the 600 courses at the Bachelor's and Master's level are taught in English, as well as many PhD level courses. Seven Master's level programmes are conducted entirely in English and one Bachelor programme is fully conducted in English every other year. Besides theoretical and scientific education, emphasis is placed on practical training. Around 30% of UMB students conduct part of their studies abroad. In addition, the Continuing Education Programme offers research-based courses geared towards the public and private sectors.

Study programmes
UMB's study programmes and courses are research-based, maintain a high degree of scientific and pedagogical quality and are described, conducted and evaluated in accordance with the intentions of the Norwegian Quality Reform of Higher Education. Focus is placed on strengthening staff-student interaction, increasing the scope of study and assessment methods, promoting internationalisation, and improving the students' general learning environment.

Internationalisation
In total, there are some 2,600 students at UMB, of which more than 10% are international students. UMB has exchange agreements with approximately 50 universities worldwide, including 6 Nordic, 44 European and 8 North American institutions. Moreover, UMB has various institutional partnerships with universities in southeastern Europe and in developing countries in the South. These partnerships are mainly carried out through the Department of International Environment and Development Studies/Noragric.

Continuing education
UMB's activities in the field of continuing education are coordinated by the Centre for Continuing Education (SEVU), which uses up-to-date information technology as a distance-learning tool for its students.

Overview of academic calendar 2006/2007

Autumn semester 2006
Introduction Week for new international students: 7-13 August
Registration period for new students: 12 - 13 August
Semester start: Monday week 33
August block: weeks 33, 34, 35 and Monday - Wednesday week 36
Matriculation (for degree students): Friday 18 August, 12:30 am, Aud. Max.
Deadline for registration/withdrawal from August block: Friday 18 August

Introduction course for all new students: Wednesday, 23 August from 12 pm
Examinations in August block: Wednesday of week 36
Autumn parallel period: Monday of week 37 - Friday of week 49
Deadline for registration for Autumn parallel: 15 September
Deadline for Semester fee payment: 15 September
Deadline for registration for re-examinations in January: 15 September
Deadline for withdrawal of Master's thesis: 15 November
Deadline for withdrawal from Autumn parallel: 24 November
General student assembly: 29 November, 12:15 - 16:00
Deadline for submission of Master's thesis: 15 December
Examination period in Autumn parallel: weeks 50 and 51
Semester ends: Friday of week 51

Spring semester 2007
Re-examination period: week 1
Semester starts: Monday of week 2
January block: weeks 2, 3, 4, and Monday - Wednesday week 5
Deadline for registration/withdrawal for January block: 15 January
Examinations in January block: Wednesday week 5
Spring parallel: Thursday week 5 - Friday week 20
Deadline for Semester fee payment: 10 February
Deadline for registration for Spring parallel/June block/re-examinations in May: 15 February
Deadline for withdrawal of Master's thesis: 15 April
General student assembly : 2 May
Deadline for withdrawal from Spring parallel/June block: 30 April
Re-examinations: Saturdays 5 and 12 May
Deadline for submission of Master's thesis: 15 May
Examination period Spring parallel: weeks 21, 22, 4 June in week 23
June block: Tuesday week 23 to Friday week 26, and week 32
Examinations in June block: Friday week 26
Semester ends: Friday week 26

If the above dates fall on a Saturday, Sunday or public holiday, dates and deadlines are postponed to the next working day. There is no teaching from Monday before Easter until Easter Monday; teaching starts again on the first Tuesday after Easter. There is no teaching on Whit Monday.

SiT – STUDENT INFORMATION CENTRE

The Student Information Centre answers most of the questions from UMB's potential students, students, and graduates. In addition to SiT, there are student advisors on all study programmes.

For general questions:
- Admission
- Semester registration
- Registration for exams
- Course catalogue
- Student advising

- Student exchange programs
- Etc.

Please contact the Student Information Centre at:
Phone: (+47) 64 96 61 00 Fax: (+47) 64 96 60 21
Email: sit@umb.no

Photo: Håkon Sparre

RULES AND REGULATIONS

On the SiT website (www.umb.no/sit) you will find all study regulations and guidelines for the Norwegian University of Life Sciences (UMB). You will also find an English-Norwegian, Norwegian-English list of administrative terminology used in academia.

The terminology list is approved by the Norwegian Council for Higher Education.

Rules and Regulations
The regulations were revised in spring 2006. The revised regulations come into force on 1 August 2006, with the exception of the Admission Regulations, which come into force at the start of admissions to the 2006/2007 academic year.

UMB's revised regulations as of 01 August 2006:

- Admission Regulations.
- Regulations for Studies
- Regulations for Examinations
- Regulations for awarding the Bachelor's Degree
- Regulations for the Degree Philosophiae Doctor (PhD)
- Regulations for the Degree dr.philos
- Regulations for the Doctor Scientiarum Degree

The actual regulation for awarding Master's degrees has not yet been translated by the Ministry of Education and Research.

Guidelines:

- Guidelines for Internal and External Examiners at UMB
- Guidelines for the use of Personal Computers in Centrally Administered, Written and Supervised Examinations at UMB
- Examinee Guidelines for Centrally Administered, Written and Supervised Examinations at UMB
- Examinee Guidelines for Centrally Administered, Oral Examinations at UMB
- Invigilation Guidelines for Centrally Administered, Written Examinations at UMB

Internal routines:

- Procedures for Handling Cases of Cheating
- Exam Declaration

Semester registration
In order to follow lectures, sit for examinations, submit a thesis or use student and campus facilities, students have to register each semester. Semester registration is performed online: www.StudentWeb.no

Teaching schedule
You will find the teaching schedule on the SiT website for:
- January block 2006
- Spring term 2006
- June block 2006
- August block 2006
- Autumn parallel 2006

Exams, grading system and re-examination
Information about how to register for an exam, the exam schedule, closing date for withdrawing from an exam, where to find the exam results etc.

Evaluation and exams
All courses have their own exams. Exams are held as a continuous assessment and/or a final examination at the end of the course. There may also be mandatory activities, e.g. seminars or excursions, that have to be completed before the exam.

The grading system
The course descriptions shall state whether a course uses the ”pass/fail” or letter marking system. Letter marks range from A to F, where A is the highest pass mark and E the lowest pass mark. The letter F is used to designate ”fail”. The letter grades and their general evaluation criteria are described below:

A	Excellent	An excellent performance, clearly outstanding. The candidate demonstrates excellent judgement and a high degree of independent thinking.
B	Very good	A very good performance. The candidate demonstrates sound judgement and a very good degree of independent thinking.
C	Good	A good performance in most areas. The candidate demonstrates a reasonable degree of judgement and independent thinking in the most important areas.
D	Satisfactory	A satisfactory performance, but with significant shortcomings. The candidate demonstrates a limited degree of judgement and independent thinking.
E	Sufficient	A performance that meets the minimum criteria, but no more. The candidate demonstrates a very limited degree of judgement and independent thinking.
F	Fail	A performance that does not meet the minimum academic criteria. The candidate demonstrates an absence of both judgement and independent thinking.

If ”pass/fail” is used, the limit for what is considered ”pass” must be determined by the course responsible and external examiner. A ”pass” mark shall express that the examinee has a satisfactory level of knowledge in the course.

When using an external examiner, the ”pass” mark can only be given if the person responsible for the course and the external examiner agree. If there is disagreement to whether or not the effort was satisfactory, the ”fail” mark is given.

Re-Examinations
In the Regulations for Examinations at the Norwegian University og Life Sciences (UMB), with supplementary provisions, Chapter 7, Ad.7-1 states that:

”Examinees with a legitimate reason for absence at the regularly scheduled final examination of a parallel period or examinees that have taken and failed the final examination can re-register for examination in the course in the period for resits and postponed exams ½ year after the original examination date.

Examinees with a legitimate reason for absence at the regularly scheduled final examination of a block period or examinees that have taken and failed the examination can re-register for examination in the course in the period for resits and postponed exams in the following autumn or spring parallel period.”

This means that if you either have failed an examination or have a legitimate reason for absence from an examination in the Spring Parallell or the August Block you can re-sit the exam. The examination period for re-examinations is normally the same as for the autumn period. However, for autumn 2004 it has been decided to extend the examination period by one week. The examination period for autumn 2005 is: weeks 50, 51 and 1 (2006). Week 1 (2006) will mainly be used for re-examinations. Deadline for registration of re-examination is September 15th (in general – or a specific year?)

The regulations also state that:
”Examinees are responsible for making sure that their exam registrations are correct. They must notify the Department of Academic Affairs of any mistakes within the specified deadlines.

If an examinee registers for an examination, but does not show up and take the exam, this counts as a valid attempt in the course in question, unless illness or other specific reasons can be documented.

Examinees with the right to resit an exam in a course with an "old" course code do not automatically have the right to resit an exam in the "same" course with a new course code. In such cases, it is the student's responsibility to clarify this with the responsible teacher before the registration deadline expires.”

Examinees who do not register for examinations within the specified deadlines are not permitted to take the exams. This means that students who wish to improve their mark in a course from, for example the Spring Parallel, can do so the next time the course is given.

UNIVERSITY LIBRARY

The Norwegian University Library of Life Sciences offers documentary- and lending services to staff and students at UMB. It also acts as the National Agricultural Library of Norway. Each of the

departments at the University has its own library, and these collections are registered in the University Library's catalogue, searchable on the BIBSYS database. The Library participates in the AGRIS/CARIS Network coordinated by FAO.

STUDENT WELFARE AND POLITICS

While studying, you should live your life in the best possible way. What kind of student facilities and accommodation are offered? What about social activities for students?

University Foundation for Student Life in Ås (SiÅs)
Internet address: http://www.sias.no/english/
All students in Norway must pay a semester fee to a student union. When studying at UMB, you must pay NOK 240 to the University Foundation for Student Life in Ås. This includes NOK 20 to the Norwegian Students and Academics International Assistance Fund (SAIH).

The University Foundation for Student Life in Ås was established in 1955, pursuant to the Act of 28.06.96 of Student Unions. The University Foundation for Student Life in Ås is the students' welfare organization at UMB, and shall:
- provide the students with good and reasonable welfare services
- promote the students' interests
- contribute to UMB being an attractive place to study and work

The University Foundation for Student Life in Ås is in charge of student accommodation, sports centre, book shop, print shop, restaurant and cafeterias, nursery, kiosk and room booking. SiÅs will do its best to make your every-day life as a student enjoyable. You can read more about this on the SiÅs website or in the guide «ABC for Thorvald og Thora», which all students receive when they start studying at UMB.

Studentsamfunnet in Ås (Student Community)
Internet address: http://samfunnet.umb.no/
The student community at UMB consists of 60-70 different clubs and societies that provide students a broad range of unique social activities. Studentsamfunnet in Ås is the oldest and most influential society at UMB. Studentsamfunnet owns the building that houses most of the social activities.

Student Info Portal
Internet address: http://student.umb.no/
The Student Board (NSU Ås) deals with student democracy, including the daily contact with SiÅs and contact with the different student representatives in various boards, assemblies and committees. The Student Board is the administrative head of the Student Parliament, but the Student Parliament is in charge of day-to-day operations. The Student Committee consists of elected representatives from each department + elected members of the Student Board. The highest body in the student democracy is the general assembly (Allmøtet). Here, all students have meeting and voting right. Elections to the University Board take place here. Representatives to the Student Board are elected at the general assembly, which is held each autumn and spring. The representatives to the University Board are also elected here. At the departments' general assemblies, student representatives on department level are elected. All students have meeting and voting rights on their departments' general assemblies.

UMB FACTS

The Norwegian University of Life Sciences comprises 8 departments. High professional quality, a high degree of teacher-student interaction and a pleasant social and physical environment characterise education at UMB. UMB is recognised as a leading international centre of knowledge, focused on higher education and research within environmental- and biosciences. The university's main specialisation areas are:

- Biology
- Environment
- Food
- Land use and natural resource management

Together with other research institutes established on and around the "Campus Ås", UMB provides state-of-the-art knowledge based on a broad range of disciplines. Study programmes offered at the Bachelor's, Master's and PhD level include:

- Animal Science
- Aquaculture
- Biotechnology
- Chemistry
- Applied Mathematics and Statistics
- Physics
- Spatial Planning
- Biotechnology
- Environment and Natural Resources
- Plant Science
- Forestry
- Ecology and Natural Resource Management
- Food Science
- Landscape Architecture
- Economics and Resource Management
- Development Studies
- Teacher Education in Natural Science

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Development Studies

180 study points, study programme language: English. Contact: Department of International Environment- and Development Studies - Noragric Institutt for internasjonale miljø- og utviklingsstudier - Noragric, www.umb.no/noragric

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.

The Bachelor's degree provides the graduates with the opportunity to work in international organisations, with development aid and in primary schools (with an additional pedagogical education). The Bachelor's degree also provides opportunities for further education, including the Master's programmes Development Studies (DS) -poverty, environment and collective action, Management of Natural Resources and Sustainable Agriculture (MNRSA), and Agroecology (AE) offered at UMB. By selecting given combinations of courses it is also possible to qualify for the Master's programmes Development and Resource Economics, Forestry, Forest Business, Nature-based Development and Innovation, Ecology, Management of Natural Resources and Tropical ecology and Management of Natural Resources offered at UMB. The Bachelor's degree also gives a basis for applying to similar programmes at other higher education institutions in Norway or abroad.

Admission:

Higher Education Entrance Qualification; specific requirements in science.

Internationalisation, study abroad and cooperation:

An international focus is an integral part of the programme, both thematically and institutionally. Most courses offered are concerned with international issues, several will be offered in English, and students will spend one semester at a partner university in a developing country. The programme also aims to attract international students.

As an integral part of the programme, the students will spend the 4th semester at a university in a developing country. It will also be possible to extend the stay to undertake field work for the Bachelor's project.

Noragric can offer individually tailored packages for students from our partner universities.

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 one term at one of our partner universities. It is also possible to take parts of the programme in other European countries.

Related programmes:

The programme is unique among UMB's Bachelor's programmes in that it has a core of interdisciplinary courses in development studies which are supplemented by courses in relevant disciplines. Compared with other similar programmes in Norway, this programme emphasises the interaction between the environment and socioeconomic development processes.

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 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.

Teaching- and evaluation methods:

The programme utilises a wide range of teaching and evaluation methods. Because working with 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. During the semester spent at a university in a developing country, students receive training in fieldwork methods.
The Bachelor's programme consists of courses offered by Noragric and other departments. The courses offered utilise a wide range of teaching and learning approaches.

Contents and structure of the programme:

The programme consists of the following components, totalling 180 credits: - Required introductory courses and advanced courses at Noragric (75 credits) - Required introductory courses at other departments (mathematics, statistics, Examen Philosophicum, economics, 35 credits in all) - (Restricted choice) electives from other departments (55 credits) - Final independent Bachelor's thesis (15 credits). The first year provides a multidisciplinary basis in the different disciplines involved (economics, ecology, anthropology, development studies). This provides a basis for selecting relevant courses in the following semesters. Concrete examples from Africa, Asia and Latin America will be used in the teaching. To enable students to work with both social and natural science approaches, the programme offers courses in mathematics, statistics and scientific method.

Concentration requirement:

In accordance with the UMB regulations for Bachelor's programmes, students must have at least 80 credits within the core area of development studies. This is achieved by taking 75 credits of required courses from Noragric plus a 15 credit Bachelor's thesis. The required courses are: Introduction to Development Studies (10 credits), Social Anthropology (5 credits), Environment and Development (10 credits), Development Aid and Politics (5 credits), semester abroad (25 credits), Global Change (10 credits), Policy and Legal Regimes (5 credits), Writing Seminar (5 credits).
Students must have an approved study plan. To be approved, the elective part of the programme should follow an example plan within one of 7 thematic areas or demonstrate an academic focus in another area of the student's choice. The student must take a minimum of 100 sp at the 200 level. Supervisors will provide guidance regarding the choice of electives. The thematic focus areas are: Institutions and Social Theory, Development Economics, Pollution, Water and Soils, Agroecology, Ecology and Genetic Resources.

Student advising

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. Individual guidance will be provided in this process.

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.

Studyprogrammes Master 2-year English

Agroecology

120 study points, study programme language: English. Contact: Department of Plant and Environmental Sciences (IPM), www.umb.no/ipm

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.

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

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.

Internationalisation, study abroad and cooperation:

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.

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.

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.

Related programmes:

The programme content is interdisciplinary and addresses the entire farming and food system. Consequently, it is an alternative to programmes focusing on single components of these systems. The pedagogical approach based on experiential learning, learning is similar to that of the Master,s degree programme in Development Studies.

Learning outcomes:

As general learning goals, the graduates of the programme should: - Have knowledge of farming and food systems - Have the ability to handle complexity and change - Have the ability to link theory to real-life situations - Be good communicators and facilitators - Be autonomous and lifelong learners. Knowledge goals: - Agroecosystem/food system structure and functioning - Methods for dealing with complex issues in agriculture and the wider food system, including systems analysis and assessment of overall system sustainability - Specific features of ecological agriculture (organic farming) Skills goals: - Action competence: how to manage complexity and change, bridge the gap between knowing and doing, transform knowledge into action and link theory to practical situations - Teamwork - Communication - Autonomous, life-long learning (learning how to learn). Attitudes goals: - Learning to deal with ethics and personal and cultural values - Personal attitudes such as being open-minded, critical, spirited, determined, approachable, exploring and communicative.

Teaching- and evaluation 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.
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 and structure of the programme:

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) (PAE302 and PAE303).

Concentration requirement:

The first semester consists of systems knowledge, 30 credits. After this the student can choose an area of concentration on various topics, see above, constituting 30 or 60 credits. The study programme concludes with a Master,s thesis constituting 30 or 60 credits.

Student advising

The courses in the first autumn semester are based on facilitated project work. Students are also advised regarding their study plan and future 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:

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.

Aquaculture

120 study points, study programme language: English. Contact: Department of Animal and Aquacultural Sciences (IHA), www.umb.no/iha Institutt for husdyr- og akvakulturvitenskap (IHA), www.umb.no/iha
The aquaculture industry is growing both in Norway and abroad. The industry requires leading knowledge of breeding, nutrition, engineering, product quality and economics at the Master,s degree level.
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.

Admission:

Bachelor,s 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. Applicants must have university level courses with a total of 180 credits in basic knowledge in nutrition, chemistry and physics .

Internationalisation, study abroad and cooperation:

The study programme is open for both Norwegian and international students.
Sections of the programme may be completed abroad. 20 credits are optional courses, and 35 credits are aquaculture related topics at minimum 200 level. 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.
Lectures are given in English.
Akvaforsk, Department of Economics and Resource Management, Department of Mathematical Sciences and Technology.

Learning outcomes:

Students will specialise in fish nutrition, fish breeding and technique. They will then be able to apply their knowledge to solve practical problems, participate in development projects and keep themselves up-to-date in scientific literature and news. Students should be able to solve practical problems based on their acquired specialised knowledge and be able to place practical solutions into a broader social perspective regarding general values within society, such as utilisation of resources, environment and animal welfare.

Teaching- and evaluation methods:

Teaching methods are varied and include lectures, field trips, group work, independent studies and exercises and seminars by students.
Final examinations, oral or written or internal assessment.

Contents and structure of the programme:

A Master degree in Aquaculture consists of:35 mandatory credits at the 300 level within fish-breeding, fish nutrition, special courses in aquaculture and planning and design of aquacultural plants. 35 credits at the 200 level within breeding, nutrition, techniques and environment, product quality and other related courses. 20 credits at the 200 level are electives. In addition, candidates must complete a Master,s thesis worth 30 credits, which may be upgraded to 60 credits on application to the Board of Education. Students who do not have a Bachelor,s degree in Aquaculture from UMB must have an individual study plan.

Concentration requirement:

The student will have a specialisation of at least 80 credits.

Student advising

The programme has a student adviser.

Quality assurance:

Approval of all alterations and rules in the Study Committee. Mid-semester and final course evaluations are considered by the Board. The quality and content of the programme as a whole is continually re-evaluated by the Study Committee.

Development and Resource Economics

120 study points, study programme language: English. Contact: Department of Economics and Resource Management (IØR), www.umb.no/ior Institutt for økonomi og ressursforvaltning (IØR): www.umb.no/ior
Why are some countries poor and some rich? Why have some countries experienced much faster economic growth than others? Why is the environment being degraded when almost everyone agrees that this is bad? Why are resources exploited in an unsustainable way? And how is poverty - and economic growth - linked to the environment? How should policies change to accommodate environmental and poverty concerns? These are big questions without simple answers. This Master,s degree programme provides students with tools to address such questions. It gives a solid basis in economic theory and methodology, while maintaining an applied profile. The programme of study is policy-oriented with special emphasis on management of natural resources, poverty and rural development and the link to national policies and trade. Policies in developing countries are often inadequate, poorly integrated, contradictory and even counterproductive. 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 of study is designed as a response to this need.
Graduates may work at universities and other teaching and research institutions, or in key positions in national ministries or regional departments of agriculture, forestry, environment, and in development planning. Many graduates have been accepted to Ph.D. studies in various universities.

Admission:

Bachelor's degree or equivalent with a major or specialisation in economics.

Internationalisation, study abroad and cooperation:

Related programmes:

Many of the courses in the programme may also be elected by other students at the university, especially other economics students and students taking the programme Development Studies.

Learning outcomes:

The course aims to give the students: - a solid basis in economic theory, with a specialisation in development and resource economics; - knowledge, training and practical experience with economic methodologies, as a bridge between theories and policy relevant problems; - deeper insights into the links between the social well-being of rural people, their natural resource base, and the underlying causes of poverty and environmental degradation; - insight into relevant policies for poverty reduction, promotion of economic development and conservation of the natural resource base.

Teaching- and evaluation methods:

The courses emphasise student participation, with exercises, group work, and hands-on experience with modern analytical tools and computer software.
Emphasis has been placed on ensuring variation in the exam and evaluation methods used in the programme.

Contents and structure of the programme:

The programme normally takes two years of full-time studies. Of the 120 credits, a minimum of 45 have to be at the 300 level. Three semesters are used for course work, while the last semester is dedicated for writing a Master,s thesis based on research in a developing country. Thesis fieldwork (2-3 months) is done between the 2nd and 3rd semester. The typical course schedule: Autumn first year: - ECN212 Microeconomic theory, - ECN201 Econometrics, - ECN270 Resource and Environmental Economics, - ECN230 The economics of international trade, Spring first year: - ECN251 Development economics - micro, - ECN352 Development economics - macro, - ECN351 Research in Development Economics, - BUS232 Decision Modelling,Fundamentals or - BUS231 Decision Modelling, Principles - a course in Resource economics or Environmental economics, The summer semester (May - August) is used for fieldwork and thesis preparation. Fall second year (main courses): - ECN350 Development and environment - ECN330 International economics or ECN310Analysis of agricultural markets Spring second year: - Master,s thesis

Student advising

The program has a Student Adviser and there is a close contact betweene the teachers and the students in training and practical experience with economic methodologies

Quality assurance:

Teachers and the department actively use information from the UMB routines for web-based student course evaluation to improve the courses. In addition, most teachers have mid-term and final evaluations of the courses. For the programme as a whole, there is continuous student evaluation and a more comprehensive, written student evaluation for the SIU/NORAD application. The programme is run by an active group of development economists that is heavily involved in and committed to the programme. There is close contact with the international academic environment to ensure that the course content is up to date. This has resulted in continuous changes in the programme, both in course composition, course content, and teaching methods. The programme is regularly (every 3 years) assessed by SIU in relation to the application for NORAD scholarships.

Development Studies

120 study points, study programme language: English. Contact: Department of International Environment- and Development Studies - Noragric, www.umb.no/noragric Institutt for internasjonal miljø- og utviklingsstudier (Noragric). www.umb.no/noragric

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 knowledge of technological, biological, economic, and agronomic approaches to innovation, income generation, and sustainable resource management.

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.

Admission:

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

Internationalisation, study abroad and cooperation:

This is by its very nature an international programme, and about 60% of the students were international in 2003/2004. Students that choose a specialisation within Conflict and Development will spend their third semester abroad at a cooperating university in a developing country, such as the University of Makerere in Uganda, the Tribhuvan University in Nepal or Egerton University in Kenya. Many students in the other specialisations also pursue course work abroad. 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.

See 'cooperation with other institutions'.

Students from partner institutions are naturally welcome to attend the programme, and quota stipends within the programme are awarded to such students. All instructions are in English. Noragric offers individually tailored course packages for visiting students.

Within two of the specialisations, 15 points in the standard programme are taken at a co-operating university in a developing country.

Related programmes:

The programme shares some courses with the Management of Natural Resources and Sustainable Agriculture programme. Some of the courses in the specialisations may also overlap other programmes at UMB. For example, Rural Development Economics students follow courses offered at the Department of Economics and Resource Management, and environmental technology students share some courses with students at the Department of Mathematical Sciences and Technology, etc. Two other departments are central to this programme, as they are in charge of different specialisations within the programme (the Department of Economics and Resource Management, Department of Mathematical Sciences and Technology).

Learning outcomes:

The programme Development Studies encompasses four different specialisations: 1) Conflict and Development, 2) Environmental Technology and Development, 3) Rural Development Economics, and 4) Biodiversity, Genetic Resources and Development. The specific aims will therefore vary according to choice of specialisation. Ethics is central to this study programme. One of the aims of the programme is to help students to understand and appreciate values related to human and societal variation and diversity. These values will be emphasised in group work, in lectures, and of course also in the interdisciplinarity which forms the foundation of the programme. After having completed the programme, the students are expected to have developed attitudes that reflect respect and humility towards the diversity of values and worldviews that exist. 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 gain the following skills: Students that complete the programme should, regardless of specialisations, have attained a level of understanding and knowledge that enables them to: - identify central approaches/analytical concepts relating to the term development; - contribute to conflict analysis and conflict resolution; - formulate and initiate high quality research and development projects; - employ a broad range of methodological approaches within qualitative and quantitative analysis. Students within the specialisation Conflict and Development should in addition 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; - identify methods previously used to manage and solve similar conflicts; - specify the strengths and weaknesses of such methods. Students within the specialisation Rural Development Economics should in addition be able to: - understand economic theory and relate this to rural development; - integrate and employ knowledge of rural- and development economics in order to develop relevant policies for poverty reduction and promotion of economic development. Students within the specialisation Environmental Technology and Development should in addition be able to: - understand how natural resources can be used to create development with the aid of environmental technology. Students within the specialisation Biodiversity, Genetic Resources and Development should be able to: - identify different problems and processes within management of genetic resources and biodiversity and suggest different ways of solving or altering these.

Teaching- and evaluation 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 themselves 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. Some courses will consist of lectures with a final examination. Most courses aim at a mixture of evaluation approaches, where some of the students, work is evaluated continuously on a pass/fail basis, while the final grade is determined by a final examination or semester assignment. A certain level of variation will exist depending on specialisation, and some courses will only have a final examination, or one single hand-in of a semester assignment.

Contents and structure of the programme:

The programme is of two-year duration. Four specialisations are available: Conflict and Development, Management of Genetic Resources and Biodiversity, Rural Development Economics, and Environmental Technology and Development. Given four different specialisations, there will inevitably be some variation in the study schedule. Nonetheless, the programme will consist of several required core courses. One of the core courses will be within the field of development theory. Other core courses include Political Ecology and a writing seminar. The programme is

structured in the following manner: All courses are at the 200 and 300 level, with a majority of 200-level courses the first year, and 300-level courses the final year where in-depth studies in the various specialisations are emphasised. The amount of optional credits varies between the specialisations. As a default, students are expected to hand in a Master,s thesis of 30 credits, but students with course experience from earlier studies and with academic ambitions may be permitted to complete a thesis of 60 credits.

Concentration requirement:

The second year of the programme, and parts of the first, will be used for in-depth studies within each specialisation, including a Master,s thesis. Within the specialisation Conflict and Development, in-depth studies at the 300 level will normally include courses in Conflict and Development (10 credits), Political Ecology (5), Research Methods (5), and Gender and Development (5). Within Management of Genetic Resources and Biodiversity, courses normally include Research Methods (5), Management of Genetic Resources, Law and Policy (10), and Political Ecology (5). Within Rural Development Economics, courses normally include Macroeconomics (5), Research Methods (5), Development and Environment Economics (15), and Political Ecology (5). Within Environmental Technology and Biological Diversity, courses normally include Research Methods (5), Ecological and Conventional Systems for Treatment of Water (15), and Political Ecology (5). Each student makes an individual plan of study that must be approved.
An introductory block has been developed that aims to introduce the students to main themes and central concepts pertinent to the programme, such as interdisciplinarity, as well as providing an introduction to the different specialisations. Moreover, the students are encouraged to participate in relevant seminars that are held at UMB and in the Oslo area. A limited amount of economic support will be provided to stimulate students, social activities that may also be of relevance academically.

Student advising

Students will be followed closely, both individually and in groups. Upon their arrival at Noragric, students will be assigned a supervisor with whom the students will collaborate in developing a study plan. During the first core course, Development Studies I, students are involved in several individual and group assignments under the close supervision by staff involved in the course. In their final year, the students will be assigned a Master,s thesis supervisor who is involved in the development and finalisation of the Master,s thesis project.

Quality assurance:

The main basis for programme evaluation is student evaluations of different courses and different specialisations. These will be discussed in the Noragric Study Committee and in the DS Academic Council (an inter-department forum).

Feed Manufacturing Technology

120 study points, study programme language: English. Contact: Department of Animal and Aquacultural Sciences (IHA), www.umb.no/iha Institutt for husdyr- og akvakulturvitenskap (IHA), www.umb.no/iha.
Feed manufacturing is an enormous global industry. Industry needs expertise of feed manufacturing technology for maximum use of limited feed resources.
The study qualifies for relevant leading positions within the feed manufacturing industry. The Master degree also gives possibilities for Ph.D. studies within feed manufacturing technology.

Admission:

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 .

Internationalisation, study abroad and cooperation:

The programme of study is open for Norwegian and international students.
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:

The main aim for the Master,s programme in Feed Manufacturing Technology is to provide a quality education for higher-level management in feed manufacturing and related industries. Students must have higher-level knowledge of the interactions between nutrition, chemistry and feed processing. Students will be able to practically manage a feed processing plant and optimise feed production according to sustainable standards.

Teaching- and evaluation methods:

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

Contents and structure of the programme:

3 semesters of teaching and a final semester with thesis work of 30 credits. The programme is based on a series of mandatory core subjects (75 credits). Students may complete the remaining 15 credits by choosing other subjects offered at the Norwegian University of Life Sciences (UMB).

Concentration requirement:

50 credits at the 300 level within Feed Manufacturing Technology and a Master,s thesis worth 30 credits.

Student advising

The programme has a student adviser.

Quality assurance:

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

Management of Natural Resources and Sustainable Agriculture

120 study points, study programme language: English. Contact: Department of International Environment and Development Studies - Noragric.

Poverty reduction depends on competent analytical and management capacity both in the public sector and civil society at large. To build this capacity, students explore the complex relationship between poverty and the environment. The focus is on the importance of natural resource management and sustainable agriculture as means of poverty reduction and sustainable development in rural areas. Graduates are expected to contribute with integrated and innovative solutions to complex problems, fostering action and change to overcome people's economic, social and physical vulnerability. The Master,s degree programme in Management of Natural Resources and Sustainable Agriculture (MNRSA) offers insight into environment, poverty and development issues. It addresses the complex and interrelated topics of agricultural and rural development, poverty alleviation and the trade-offs and conflicts between development at large and the long-term management and conservation of natural resources and biodiversity.

Students in the programme are often already employed in public sector ministries and directorates of natural resources, conservation and agriculture-related fields. Some graduates become planners and managers at senior levels. Others join the private sector as consultants, or join NGOs working with rural development, agricultural development and natural resource management. Others become teachers or researchers, and even enter into politics. Students who have completed the degree are qualified to apply for Ph.D. programmes in the area of environment and development.

Admission:

Bachelor,s degree or equivalent education in any field relevant to natural resource management (e.g. economics, political science, ecology, biology, anthropology, resource management, geography, etc.)

Internationalisation, study abroad and cooperation:

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 and agriculture. The students focus their thesis on global problems in these fields and do their fieldwork in southern countries. During the third semester (1 August - 31 September), the students take a 15-credit course at Noragric's regional partner institutions, for example Makerere University in Uganda and at Tribuwan University, Institute of Forestry, Pokhara, Nepal.

During the third semester in the MNRSA programme, the students participate in a 15 ECTS course at Makerere University in Uganda, Tribhuvan University, Institute of Forestry, Pokhara, Nepal, or another developing country partner institution.

Noragric can offer individualised course packages taught in English for visiting students.

The third semester of the programme is taught at a partner institution in a developing country.

Related programmes:

This study programme is unique both nationally and internationally as it combines natural resource management and agricultural development. In the context of UMB, it is has an unusually strong interdisciplinary profile and focuses on the link between the natural and social sciences.

Learning outcomes:

The programme educates graduates who can actively contribute to development processes in their home countries. Graduates of the programme: -have heightened awareness, analytical capacity and research-based knowledge in the fields of poverty, rural development, natural resource management, environment and sustainable agriculture, -have first-hand experience with capacity-building and development work in the south and collaboration efforts between UMB/Noragric and partner institutions in the south, -understand 'nature-society relationships' from both theoretical and experiential perspectives, -are proficient learners and have learned to learn -are capable of seeking, interpreting and generating practical processes of social change in terms of empowerment, equitability and sustainability -have critical and analytical minds -are concerned about combined concerns of sustainability, equity, gender and human rights.

Teaching- and evaluation methods:

Teaching methods in the MNRSA programme include lectures, problem-based learning, Internet-supported teaching (IST), group work, fieldwork and seminars. Increased emphasis will be given to internet-supported teaching as it has been shown both in Norway and abroad that a combination of Internet and classroom pedagogics is an effective educational approach. Throughout the learning process, emphasis is put on developing skills to search for, gather and evaluate information. Teaching staff members cooperate closely with ICT and library staff to integrate this aspect into the course work. Information management will be of value to the students not only during the course work and thesis writing, but even more so in their future life as managers and decision makers in the information society. The seminars allow the student to develop skills in oral presentation and in scientific writing. Students interact dynamically by giving and receiving criticism in constructive ways. Such skills are essential in real-life situations in their respective countries. Case studies given by guest lecturers and articles chosen for the seminars cover hot topics about which students organise discussions.

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

Contents and structure of the programme:

Upon arrival, most students take an optional, introductory course exposing them to current challenges in the field of environment and development, as well as preparing them for challenging university-level studies in Norway. The Master,s programme is a two-year, full-time programme of study consisting of required and elective course work, a semester of field study at a co-operating university in a developing country at the start of the second year and production of an individual, 30- or 60-credit thesis. All students are required to take the following courses: EDS 385 - Rural Development and Project Management (15 credits) EDS 310 - Manren, main course (15 credits) EDS 300 - Research methods (10 credits) HOVMNRSA - Thesis (30 or 60 credits) The rest of the 120 credits consist of relevant electives at the 200 or 300 level offered by Noragric, other departments at UMB or other universities. The study plan must be approved by the student's advisor and the Education Committee and fulfil the requirements for breadth and depth described below. The Master's thesis normally comprises 30 credits, but students with a strong background and high ambitions can apply to write a 60-credit thesis.

Concentration requirement:

Students must complete an individual study plan that has been approved by the supervisor and the Noragric Education Committee. The first version of the plan must be approved during the first month of residence. The student's background and individual interests and goals are the basis for constructing the individual study plan. To achieve depth of understanding of interdisciplinary environment and development issues, students are required to take the 3 courses listed above and to write a 30- or 60-credit thesis based on an interdisciplinary topic and research approach. Over and above these core requirements, students must demonstrate through previous course work or course work taken as part of the degree that they have competence at the 200 or 300 level in a range of academic subject areas fundamental to an interdisciplinary understanding of environment and development issues ('distribution requirements'). Competence must be demonstrated in each of the following areas: biology/ecology/agriculture (minimum 10 credits), scientific writing and communication (minimum 5 credits), social sciences not including economics and administration (minimum 5 credits), economics/administration (minimum 5 credits), statistics (5 credits). Most students will fulfil

some of these requirements through previous studies, allowing them to explore other electives. Noragric offers a range of courses that are suitable for fulfilling these requirements. Students will receive individual guidance and examples to help them construct a programme suited to their background and ambitions.
A minimum of 60 credits must be at the 300 level, including thesis work. Up to 10 credits of the 120 credits counting toward the master degree may be at the 100 level.

Student advising

Immediately after arriving, students will receive guidance in order to make their individual plan of study. The students have access to advisors 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. The student is also assigned a local supervisor while in the field. This person helps the students with both practical and more theoretical issues and ensures that the research questions are relevant in the given field situation. Efforts are made to ensure that research topics chosen relate closely to research and development activities in the institutions with which Noragric has institutional co-operation, if possible.

Quality assurance:

The administration has regular meetings with students throughout the semester and MNRSA students participate in the electronic student evaluations carried out by the UMB central administration at the end of each semester. Faculty members analyse the student evaluations and suggest relevant actions. As a SIU/NORAD-funded programme, it is subject to periodic external evaluations.

Tropical Ecology and Management of Natural Resources

120 study points, study programme language: English. Contact: Department of Ecology and Natural Resource Management (INA): www.umb.no/ina Institutt for naturforvaltning (INA): www.umb.no/ina

The importance of conservation and sustainable use of biological diversity is currently internationally recognized, for instance through the Convention of Biological Diversity (CBD), signed by more than 170 countries. The CBD obliges nations to ensure the conservation of biodiversity, its sustainable use, and equitable sharing of all benefits arising from its use. The students in this degree programme will gain knowledge that is relevant to the sustainable management of biological resources in a variety of landscapes ranging from agro-forest, semi-natural to natural ecosystems in the tropics. Through exposure to fundamental and applied understanding of how tropical systems function under natural and managed circumstances, students will be able to work with applied management of tropical natural resources. In Norway and Europe, this education provides the competence to obtain work in advisory or managerial positions within natural resources or environmental management. 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. Students can opt to pursue a doctoral degree after obtaining this Master,s degree.

Admission:

The applicants must have obtained a Bachelor,s of Science degree or equivalent in Natural Sciences (biology, ecology, agricultural or environmental sciences).

Internationalisation, study abroad and cooperation:

All courses in this programme are taught in English, and the programme focuses on international questions in ecology and natural resource management. The programme is open for international students.

The duration of the programme is two years, starting in August. Year one consists of course work at the Norwegian University of Life Sciences, and the second year is set aside for individual research and writing a Master,s thesis. The field research is conducted in a tropical/subtropical area and lasts for three to six months.

Since the programme is run in English, it is well suited for international candidates. The programme is specially designed to target students from our partner universities in developing countries.

Several of our present students work with our collaborating institutions in Asia and Africa.

Related programmes:

There are very few Master,s degree programmes that specialize in the ecology and management of tropical natural resources in Europe. The programme is related to the Master,s degree programmes in Ecology and in Management of Natural Resources, but these programmes do not focus specifically on tropical ecosystems.

Learning outcomes:

This degree programme provides a thorough knowledge of the biology and ecology of the tropics. Through an interactive approach, students obtain: 1) a solid understanding of the concepts in ecology dealing with populations, communities and ecosystems through case studies 2) an in-depth knowledge of species behaviour/responses and interactions (including symbioses) in different systems 3) an understanding of tools for species extractions, field methodologies, analytic techniques, restoration, management strategies, conventions, etc. applicable to a range of systems (natural to agro-forest systems) 4) insight into the human activities that shape, maintain and manage ecosystems

Teaching- and evaluation methods:

The study programme consists of courses of longer duration (1 semester) and of shorter, more intensive courses covering a few weeks. In addition to ordinary lectures, the teaching will often require interactive student participation through presentations, short thematic reviews, semester assignments and discussion sessions. The Master,s thesis consists of fieldwork, data analyses and writing a scientific paper.

Written exams are the most common criteria for evaluation, but oral exams, evaluations based on semester assignments and class presentations will also be used. The students must defend their Master,s theses orally.

Contents and structure of the programme:

The first year of this Master,s degree programme consists of course work at the Norwegian University of Life Sciences (UMB). The following courses are compulsory: -ECOL250 Tropical Ecosystems and Biodiversity, 5 credits -NATF320 Ecology and Management of Natural Resources in the Tropics, 15 credits -ECOL350 Restoration Ecology, 5 credits -NATF350 Community Based Natural Resource Management, 5 credits -EDS220 Statistical Analysis 10 credits (only for students lacking a statistical background) The second year is set aside for individual research projects. The research projects will result in a Master,s thesis.

Concentration requirement:

To gain adequate specialisation in the programme, it is required that students have at least 30 credits at the 300 level. At least 5 of these credits shall be from the special syllabus. This syllabus is related to the topic of the student,s Master,s thesis and is put together by the student and the supervisor. Students complete the programme with a Master's thesis that is a scientific work that students conduct within one of the specialisation areas. The student conducts the thesis with guidance from a scientific member of staff.

Student advising

The students will obtain information about the study from the department's own student adviser, from the programme coordinator, from the teachers responsible for different courses, and from their thesis supervisor.

Quality assurance:

Teachers ensure that a mid-semester evaluation is completed in most courses. As well, students evaluate courses through UMB's web-based system. These evaluations are considered annually by the teachers and by the department,s Study Committee. The teacher must write comments on the evaluations with potential suggestions for improvement. These are approved by the Study Committee. Both external and internal evaluation of the course will take place at regular intervals.

AKA250 Organisation of Breeding programme in Aquaculture

Organisation of Breeding programme in Aquaculture

Credits: 5 **Language:** English upon request
Staff/institute: Hans Magnus Gjøen/ IHA
Start term: January block
Terms: January block
Mandatory activities: Submission of case projects
Prerequisites: Statistics similar to STAT100 and genetics similar to BIO120.
Type of course: 22 hours of lectures + 130 hours of colloquium, case projects and reading
Contents: The course provides an introduction to the various breeding programmes used for fish and shellfish. The students will learn about the major principles used to organise the various schemes, biological restrictions for species involved, and economical considerations. Simple breeding programmes with relatively low costs involved for commercial operators of various species will be described. An overview of software available for planning and operation of such programmes will also be provided.
Learning goals: The students will learn about the major breeding programmes for fish and shellfish; their organisation, structure and costs involved. The students shall be able to evaluate various programmes and plan a simple cost-efficient breeding programme for a commercial brood stock operator.
Methods of examination: Final Written exam **Grading:** A-F
Assessment methods: Compulsory case project and a final written exam.
Examination aids: No calculator, no other examination aids

AKA251 General aquaculture breeding and genetics

General aquaculture breeding and genetics

Credits: 5 **Language:** English
Staff/institute: Hans Magnus Gjøen/ IHA
Teachers: Teachers from the Norwegian School of Veterinary Science.
First time the course is offered: SPRING
Start term: January block
Terms: January block
Mandatory activities: Group work on case studies, written or oral presentation
Prerequisites: BSc in life science or ongoing BSc studies at UMB.
Credit reduction: AKX250 100%
Type of course: 25 hours of lectures + colloquium, case projects and self-study
Contents: In this couse students will learn about the major principles used to design the various breeding schemes, biological restrictions for species involved, and economical considerations. Simple breeding programmes with relatively low costs involved for commercial operators of various species will be described. The course is arranged in collaboration with the NOVA Aquaculture and Freshwater Fisheries education network (http://www.nova-university.org/novadb/courses/) and is one of the four theoretical blocks of AKX250. Lectures, exercises and literature are synchronized with the students following AKX250, but students taking AKA251 (this course) will in addition perform an individual project.
Learning goals: Students will learn about basic aquaculture genetics and breeding, in additon to the major breeding programmes for fish and shellfish; their organisation, structure and costs involved. The students shall be able to plan a simple cost-efficient breeding programme for a commercial broodstock operator.
Methods of examination: Continous assessment **Grading:** A-F
Assessment methods: The written exam and the individual project will contribute 80% and 20%, respectively, to the final grade.

AKA310 Fish Breeding, Reproduction and Gene Technology

Fish Breeding, Reproduction and Gene Technology

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

Staff/institute: Hans Magnus Gjøen/ IHA
Teachers: Bjarne Gjerde, Ingrid Olesen, Kari Kolstad, Øyvind Andersen and Dag-Inge Våge
Start term: Spring parallel
Terms: Spring parallel
Mandatory activities: Submission of assignments/case
Prerequisites: General knowledge of animal husbandry, HFA200
Type of course: Teaching: 40 hours
Contents: Lectures will cover the following topics: breeding strategies, breeding methods and breeding goals, estimation of breeding values, genotype by environment interactions and the application of modern DNA-tools in aquaculture.
Learning goals: Students are to acquire sound knowledge in the use of traditional and modern fish breeding methods. The students are to gain skills in the evaluation of various strategies and methods and be able to understand the principles of estimating various breeding parameters.
Methods of examination: Final Written exam **Grading:** A-F
Assessment methods: Written examination.
Examination aids: No calculator, no other examination aids

AKE251 General aquaculture - nutrition

General aquaculture - nutrition

Credits: 5 **Language:** English
Staff/institute: Anders Kiessling/ IHA
Teachers: Trond Storebakken and teachers from the Norwegian School of Veterinary Science.
First time the course is offered: AUTUMN
Start term: Autumn parallel
Terms: Autumn parallel
Mandatory activities: Literature exercises, individual project, including a written report.
Prerequisites: BSc in life science or ongoing BSc studies at UMB.
Credit reduction: AKX250 100%
Type of course: Activities consist of lectures and literature studies for a four week period ending with a written exam. In addition, each student performs an individual written assignment.
Contents: The course is arranged in collaboration with the NOVA Aquaculture and Freshwater Fisheries education network (http://www.nova-university.org/novadb/courses/) and is one of the four theoretical blocks of AKX250. Lectures, exercises and literature are synchronized with the students following AKX250, but students taking AKE251 (this course) will in addition perform an individual project.
Learning goals: The aim of the course is to provide students with a basic understanding of nutrition with emphasis on monogastric animals such as fish. The student should reach an understanding of the main components of the diet and their interrelationships and importance for the animal.
Methods of examination: Continous assessment **Grading:** A-F
Assessment methods: The written exam and the individual project will contribute 80% and 20%, respectively, to the final grade.

AKE310 Aquaculture Nutrition

Aquaculture Nutrition

Credits: 10 **Language:** English
Staff/institute: Anders Kiessling/ IHA
Teachers: Several
Start term: Autumn parallel
Terms: Autumn parallel
Mandatory activities: Practical feed project (written and oral presentation).
Prerequisites: Knowledge of nutrition at the 200-level (BSc).

Type of course: 2-6 hours of lectures and theoretical exercises per week. 2-6 hours of practical projects per week. Remaining time spent on the individual project, literature preparation etc. Activity level: 50% of full time.
Contents: The course is project based. Student groups are responsible for a long term project, including diet formulation, chemical analysis and biological evaluation in a growth and digestibility experiment. The interrelationship between growth, environmental factors and diet will be highlighted by including water quality measurements during the experiment. The student will receive support in the form of lectures by specialists in feed formulation, nutrient sources, fish nutrition and growth. In addition the student will receive training in information search and presentation from the scientific literature in electronic databases. An individual project will focus on a specific fish nutrition related subject. The result will be presented both in writing as a small report in the form of a scientific paper and orally in the form of a powerpoint presentation.
Learning goals: 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.
Methods of examination: Continous assessment **Grading:** A-F
Assessment methods: Written project 35%, oral presentation of the project 20%. Oral examination 45%.

AKX250 General aquaculture

General aquaculture

Credits: 20 **Language:** English
Staff/institute: Anders Kiessling/ IHA
Teachers: Hans Magnus Gjøen, Odd-Ivar Lekang, Bjørn Frode Eriksen and teachers from the Norwegian School of Veterinary Science.
First time the course is offered: AUTUMN
Start term: August block
Terms: August block Autumn parallel January block June block
Mandatory activities: Preparation and implementation of field trips. Literature exercises. Oral report on the individual project as a part of last field week.
Prerequisites: BSc in life science
Credit reduction: See NOVA Aquaculture educational course database; http://www.nova-university.org/novadb/courses/
Type of course: Activities can be divided into three parts; 1) Field trips consisting of two trips, one at the start and one at the end of the course. The field trips consist of a short preparation, travel and a field week (3+2+5 days full time studies (8 h/day, 2 ect). 2) Four theoretical sub blocks each consisting of four weeks with an estimated activity 6 hours with lectures and theoretical exercises per week + individual studies (4 ect each). 3) Personal project (ca 2 ect), constructing a virtual fish farm. There is no other activity during the Spring semester; 5 h/week.
Contents: The subject consists of a mixture between field trips, laboratory exercises, lectures, literature exercises and farm operation simulation exercises. The course is arranged in collaboration with the NOVA Aquaculture and Freshwater Fisheries education network (http://www.nova-university.org/novadb/courses/) and is initiated by a joint field week, followed by four separate blocks of theoretical studies. The course ends with a joint field week. The four blocks are given from early Autumn parallel through out the January block and consists of 1. Anatomy - health, 2. Genetics-breeding, 3. Nutrition and 4. Production. Each block is ended by a written exam and includes a literature exercise. Between the January and June block the student will be given an assignment consisting of constructing a production plan using an online programme simulating a virtual farm. Distance participation is possible, except for the two field weeks. It is also possible to only participate on individual blocks (1-4, given above). If so, use their respective course codes (AKX251, AKA251, AKE251 and TAT254). The week-long field trips are reserved for participants of this course (AKX250).
Learning goals: The aim of the course is to give the student a solid base, both practically and theoretically, in fish biology and fish farming, either as an advanced introduction or in preparation for more advanced MSc courses within Aquaculture. To achieve these goals, excursions, practical exercises, laboratory exercises, lectures and self-study assignments are employed.
Methods of examination: Continous assessment **Grading:** A-F
Assessment methods: Field trips will be evaluated on performance during the week and presentation of the assignments/project during the week with grade pass/fail. In case of a 'fail' grade, individual assignments will be given allowing the student to reach the level of passed. The four sub blocks will be evaluated individually at the end of each block by a written exam. Each block

will contribute 20% to the final grade. The individual project will be evaluated based on the written report and contribute 20% to the final grade. The oral presentation of the same project will be in the form of a hearing and based on this the student will be awarded the grade pass/fail. In the case of 'fail', the student will be given assignments allowing the student the opportunity to reach the level of passed.

AKX251 General aquaculture-anatomy and health in farmed fish

General aquaculature-anatomy and health in farmed fish

Credits: 5 **Language:** English
Staff/institute: Anders Kiessling/ IHA
Teachers: Ragnar Salte and teachers from the Norwegian School of Veterinary Science.
First time the course is offered: AUTUMN
Start term: August block
Terms: August block Autumn parallel
Mandatory activities: Literature exercises.
Prerequisites: BSc in life science or ongoing BSc studies at UMB.
Credit reduction: AKX250 100%
Type of course: Activities consist of lectures and literature studies for a four week period ending with a written exam. In addition, each student is assigned an individual written project.
Contents: The course is arranged in collaboration with the NOVA Aquaculture and Freshwater Fisheries education network (http://www.nova-university.org/novadb/courses/) and is one of the four theoretical blocks of AKX250. Lectures, exercises and literature are synchronized with the students participating in AKX250, but students taking AKX251 (this course) will in addition perform an individual project.
Learning goals: The aim of the course is to give the student a base in fish anatomy and health.
Methods of examination: Continous assessment **Grading:** A-F
Assessment methods: The written exam and the individual project contribute 80% and 20%, respectively, to the final grade.

AKX252 Introduction to disease control in aquatic populations

Introduction to disease control in aquatic populations

Credits: 5 **Language:** English
Staff/institute: Ragnar Salte/ IHA
Start term: Spring parallel
Terms: Spring parallel
Prerequisites: AKX100 or equivalent
Type of course: Lectures and assignments equivalent to a work load of 6 hours a week
Contents: The course gives an introduction to epidemiology, its uses and its aims. Focus is on strategies of disease control, i.e. any measure intended to interfere with the unrestrained occurrence of disease whatever its cause or causes. Emphasis will be placed on the maintenance of wild stocks, the interactions between wild and cultured stocks, and on the management of diseases of cultured and wild aquatic populations. The students will familiarise themselves with the tools they need to evaluate a disease situation and to decide on a strategy of controlling a given disease through assignments using relevant cases.
Learning goals: Having finished the course, the students will be able to discuss factors that determine disease occurrence, transmission and maintenance of disease in cultured and wild aquatic populations, and by which methods disease can be controlled in aquaculture and in the wild. They will be able to discuss strategies of disease control, and methods of risk analysis and risk management directed towards the prevention of importing disease in a situation where the non-quantified risk of importing disease cannot be used as a trade barrier.
Methods of examination: Final Oral exam **Grading:** A-F
Assessment methods: Oral exam.

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: Presentations
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 goals: 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%.

AOS232 Strategic Management and Organisation Design

Strategic Management and Organisation Design

Credits: 10 **Language:** English upon request
Staff/institute: Carl Brønn/ IØR
Start term: Autumn parallel
Terms: Autumn parallel
Prerequisites: AOS120, AOS130, BUS100.
Credit reduction: AOS233: 10 credits.
Type of course: Approximately 80 hours, divided between lectures, group discussions, case presentations and exercises.
Contents: The course presents an integrated treatment of organisation design and strategic management. The topics covered in the course include: sense-making and the role of cognition in strategic decision making; issues in organisation design as they relate to strategy; types of strategising; internal and external analyses; the dynamic resource based view; systems thinking and strategic modelling in complex environments; strategic communications-reflection, inquiry and advocacy; scenarios and strategic conversations.
Learning goals: The course has the following objectives: ·To enable the student to explain how cognition influences the strategic decision making process and to identify actions for overcoming these effects in a strategic analysis. ·To identify and explain the distinguishing characteristics of the main organisation structure types and to discuss their relative strengths and weaknesses. ·To be able to diagnose an organisation and its environment and to make recommendations for an appropriate structure. ·To explain the important characteristics of the main schools of strategic thought. ·To be able to conduct internal and external strategic analyses. ·To use the language of systems thinking to represent organisational processes and structures for strategic analysis, decision making and implementation.
Methods of examination: Continous assessment **Grading:** A-F
Assessment methods: Semester paper (60%). Case studies and presentations (40%).

AOS233 Strategic Processes and Decision-Making

Strategic Processes and Decision-Making

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: What strategy is and a historical perspective. Strategy and issues in development studies-the case of unintended consequences. 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 goals: The objectives in this course are threefold. First, we review the impact of the cognitive dimension on strategic diagnosis and decision-making. We investigate how this dimension influences the activities that affect the organisation in developing strategy. The second objective is to provide a conceptual framework for understanding complex organisational structures as systems. This involves a review of different perspectives on strategic decision-making and the factors that influence the process. The two theoretical platforms that support this second objective are information feedback theory and behavioural decision theory. These theories provide insights into the different possible perceptions of the strategic development problem and serve as valuable learning and communication tools. These views are combined into the unified approach called systems thinking. This perspective gives the decision maker a powerful method for investigating and communicating the long-term consequences of strategic planning activities.
Methods of examination: Continous assessment **Grading:** A-F
Assessment methods: The assessment is based on a semester assignment, case analyses and presentations. Semester assignment: 60%. Cases and presentations: 40%.

APL104 Introduction to the Professions of Land Use Planning and Land Consolidation

Introduction to the Professions of Land Use Planning and Land Consolidation
Credits: 5 **Language:** English upon request
Staff/institute: Ingerlise Amundsen/ ILP
Teachers: Sigmund Asmervik, Hans Sevatdal, August Røsnes, Erik Aas jr, Sølve Bærug.
Start term: August block
Terms: August block
Mandatory activities: It is assumed that students take part in class excursions and surveys.
Type of course: Lectures: 30 hours Seminars/study groups with the teacher present: 30 hours Group work/projects/exercises: 80 hours
Contents: Supervision and study adjustments will be available. An excursion of 2-3 days will be arranged. During the excursion, there will be focus on technical approaches to land use planning and land consolidation, through lectures given by local experts, technical discussions, practical exercises and presentations. Lectures and local inspections will give an introduction to architecture and planning expressions. Students will participate in a case-related group work which includes a presentation.
Learning goals: The new students receive their first introduction to professionals and professional studies in land use planning and land consolidation. This is partly in order to contribute to professional development through study, and partly in order to understand the progress of study through the more basic technical courses, and to increase the motivation by completing these. Students will get to know their fellow students and teachers in a connection relevant for further studies. The students will acquire basic competence in working methods and presentations common in the professions. The students will become able to describe phenomena and problems related to land use planning and tenure. The students will be introduced to ethical and interpersonal problem issues that characterise the work within the professions. The students will be introduced to typical expressions from architecture and city planning. The students will, via cooperation and exercises, acquire practice in respecting fellow students and teachers within a work and learning situation.
Methods of examination: Continous assessment **Grading:** Pass/Fail
Assessment methods: Compulsory written assignment to be handed in at the end of the teaching period. Participation in excursion and oral report in class. The evaluation will be based on presentations and group work. Immediate evaluation.

APL405 Institutional Approaches to the Enabling of Plans

Institutional Approaches to the Enabling of Plans
Credits: 10 **Language:** English
Staff/institute: August E. Røsnes/ ILP
Teachers: Hans Sevatdal, Harvey M. Jacobs.
Start term: June block

Terms: June block
The course is offered: By assignment
Mandatory activities: Compulsory participation in lectures and workshops.
Prerequisites: M. Sc. in Land use Planning or similar.
Type of course: Lectures: ca. 20 hours. Workshops: ca. 10 hours Plenary discussions ca. 5 hours.
Contents: The course includes five thematic modules: 1. The institutional aspect in planning. 2. Law as a framework for the enabling of plans. 3. Constitutional rights and property systems in planning. 4. Planning forms and regulation methods. 5. Administrative, legal and financial mechanisms.
Learning goals: The overall purpose of the course is to give the students basic knowledge for studying the enabling of plans within the fields of town and country planning. Although the main focus is directed towards investigations and research, the thematic approach will be concentrating on institutional instruments and mechanisms as active means for the realisation of plans and implementation of projects.
Methods of examination: Continous assessment **Grading:** A-F
Assessment methods: Term paper; will be submitted 6 weeks after the ending of the course.

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 - analysis of DNA sequence data, sequence comparisons, and gene detection
Learning goals: 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: Simple calculator, specified other 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
Start term: Spring parallel
Terms: Spring parallel
Prerequisites: Introduction to bioinformatics equivalent to BIN210. Programming knowledge equivalent to INF210.
Type of course: Lectures: 26 hours. Computer lab exercises: 44 hours.
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 goals: Students must be able to explain the theory behind central scoring models for sequence alignments, and thereby understand the basis of statistically based conclusions. The student will understand the optimal algorithms for sequence alignments, and implement variants of them in a high-level language. Students will know the principles behind heuristic algorithms for pairwise and multiple sequence alignments. Students will process large data sets in a modern scripting language, and retrieve relevant information from searches in international databases. Students will also be familiar with commonly used probability models for sequences, from position-weight matrices, via profiles to different variants of Markov-chain models. Students will

be able to implement the generic algorithms for hidden Markov-models. Through projects, the students will apply their acquired theoretical knowledge in solving problems, and the results will be presented in written reports as well as in oral presentations.
Methods of examination: Final Oral exam **Grading:** A-F
Assessment methods: Oral exam.

BIN320 Systems Biology

Systems Biology

Credits: 10 **Language:** English upon request
Staff/institute: Erik Plahte/ IKBM
Teachers: Stig W. Omholt
Start term: Spring parallel
Terms: Spring parallel
Mandatory activities: One or more compulsory projects or assignments will be given during the course, and must be finished before the determined deadlines. More details will be given on the course web page.
Prerequisites: The course is based on MATH100 Introductory mathematics or MATH111 Calculus 1. Students are expected to possess basic knowledge and experience from MATH130 Linear algebra, MATH140 Differential equations, BIO210 Molecular biology, INF110 Programming 1. Students who have not taken these courses may expect to make an extra effort.
Type of course: Lectures: 2 hours per week. Exercises: 4 hours per week.
Contents: Master course in bioinformatics. The first part of the course comprises training in basic mathematical techniques and methods to analyse dynamical non-linear systems (phase space analysis, equilibrium analysis, stability theory, bifurcation theory, reformulation in terms of non-dimensionalised equations and scaling, quasi-stationarity). We will emphasise the combination of traditional analysis with modern geometrical analyses and simulations. Previous experience with Matlab is an advantage. In the second part of the course a number of basic mechanisms and phenomena from cell biology and molecular biology processes are presented: one-way and two-way switches, adaptation, dose-response relationships, enzyme kinetics, the Michaelis-Menten function, positive and negative feedback, activation and inhibition, multi-stationarity, homeostasis and oscillations, etc. In the third part of the course a number of recent papers in systems biology are presented and discussed. More detailed information can be found on the course web page.
Learning goals: Students are expected to gain knowledge of and command theoretical and mathematical tools for analysing and understanding the function of cell biology systems and processes in systems biology and modern, quantitative biology, and to acquire skills in performing such analyses. In addition, students are expected to gain knowledge of: (1) Basic mathematical tools for analysing dynamical systems, (2) What systems biology is and how systems biology and systems biology thinking differs from traditional biology, (3) Basic molecular biology mechanisms in biological systems and how they can be modelled mathematically, (4) Typical examples of modelling and analysis in systems biology: Metabolic processes, signal transduction, gene regulatory processes, etc. taken from recent scientific literature. Based on this knowledge and these skills students shall be able to read recent systems biology papers containing mathematical analysis of models, but not requiring deep and extensive mathematical understanding. Students shall also develop skills in practical modelling (model analysis, simulations, interpretation and validation) and in using data based modelling tools. More detailed goals for knowledge and understanding can be found on the course web page.
Methods of examination: Final Oral exam **Grading:** A-F
Assessment methods: There is a final oral exam comprising a discussion of the assignment papers and a presentation of a subject given to the student some days in advance.

BIN350 Genome Analysis, Methodology

Genome Analysis, Methodology

Credits: 5 **Language:** English upon request
Staff/institute: Dag Inge Våge/ IHA
Teachers: Sigbjørn Lien
Start term: Autumn parallel
Terms: Autumn parallel
Prerequisites: BIN210. In addition at least one of the courses: BIO210, HFM200 and 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. During the semester, three obligatory assignments will be given, which will be the basis for the students' final grade. 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 goals: 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 **Grading:** A-F
Assessment methods: The three home assignments count 1/3 each, and are evaluated collectively at the end of the course.

BIN400 Analysis of microarray data

Analysis of microarray data

Credits: 5 **Language:** English upon request
Staff/institute: Lars-Gustav Snipen/ IKBM
First time the course is offered: SPRING
Start term: January block
Terms: January block
The course is offered: Other - Emnet tilbys bare ved tilstrekkelig interesse og dersom ressurssituasjonen tillater det.
Prerequisites: Bioinformatics equivalent to BIN210. Statistics equivalent to STAT100.
Type of course: Lectures: 20 hours, exercises: 20 hours.
Contents: The course contains both lectures and exercises, and will be based around a project that the students will work on.
Learning goals: Students will know the principles and technology behind a selection of microarray platforms. They will learn a selected set of standards for storing microarray data, and use the BASE system for documentation. They are to understand the consequences of various forms of pre-processing of microarray data. They will know a selected set of methods for clustering and data reduction, and be familiar with the consequences of different choices of metrics and scalings. They will understand the theory behind some selected methods for testing for differentially expressed genes, and correction for multiple testing. They will also be able to conduct some analysis of variance on microarray data, and design simple experiments. A suitable user software will be used for the analyses.
Methods of examination: Final Oral exam **Grading:** Pass/Fail
Assessment methods: Assessment is based on an oral exam.

BIO221 Plant Breeding

Plant Breeding

Credits: 5 **Language:** English upon request
Staff/institute: Åsmund Bjørnstad/ IPM
Teachers: Anne Guri Marøy.
Start term: Spring parallel
Terms: Spring parallel
Prerequisites: BIO120 Introduction course in Genetics or equivalent.
Type of course: Lectures: 42 hours (3x14).
Contents: The course is intended to give the students insight into genetics. Placing genetics within the frame of Plant Science. The lectures cover topics such as: resistance breeding, quality, overwintering, yield, etc. The students should have some prior knowledge of Mendel's laws, chromosomes, DNA structures etc, but these topics will also be covered in the lectures.
Learning goals: 1. Knowledge of plant breeding methods 2. To understand how breeding methods are used to develop plants with improved traits. 3. To understand the role of breeding methods in the production of food and other plant products. It is recommended that the student also follows the parallel practical course in plant genetics.
Methods of examination: Final Written exam **Grading:** Pass/Fail
Assessment methods: Written examination: 3 hours.

Examination aids: No calculator, no other examination aids

BIO222 Plant Breeding

Plant Breeding

Credits: 5 **Language:** English upon request
Staff/institute: Åsmund Bjørnstad/ IPM
Teachers: Anne Guri Marøy.
Start term: January block
Terms: January block
Mandatory activities:
Prerequisites: BIO120 or equal. If you have passed this in December you may get a hands-on in plant genetics in january and then plant breeding (PGN210,classical and molecular methods)in February.
Type of course: Exercises: 4 hours per week for 14 weeks.
Contents: The main materials are a population of barley segregating for a wide variety of morphological and other traits. Look up on kurs.umb.no or www.barleyworld.org to see more about it. We will link visual observations to DNA-based methods like PCR and gene mapping to analyse different genotypes. Other topics: Crop evolution, mutations, transgenic plants etc.
Learning goals: To understand the genetics of plants and analytical methods through practical handling of plant populations and how breeding affects crop production.
Methods of examination: Continous assessment **Grading:** Pass/Fail
Assessment methods: Journal.

BIO300 Microscopy Techniques

Microscopy Techniques

Credits: 10 **Language:** English upon request
Staff/institute: Trygve Krekling/ IPM
Teachers: Elin Ørmen.
Start term: January block
Terms: January block
Mandatory activities: Exercises, demonstrations.
Type of course: Lectures: 10-12 hours per week. Demonstrations: 2-3 hours per week. Training: 4-8 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, immune marking. 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 goals: Students are to acquire theoretical and practical knowledge in connection with optics, sample treatment and image formation so that they are able to: 1) explain central optical terms (resolution ability, magnification and more) 2) describe ray paths and image formation in various microscope types 3) make rational choices when it comes to sample treatment and depiction methods based on sample type and the problem to be solved 4) evaluate and interpret various microscope pictures (their own or published ones) Students should be capable of: A: diagnosing, adjusting and using the following microscopes: 1) Light microscopes-LM, with various types of optics (light fields, dark fields, polarisation, phase, DIC and fluorescence) 2) Confocal Laser Scanning Microscope-CLSM 3) Scanning Electron Microscope-SEM, in various depiction modes (SEI and BEI) and for element determination (X-ray analysis). 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 and High vacuum) 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 **Grading:** A-F
Assessment methods: The following will be evaluated: An approved journal: 1/3 of final grade. An oral examination: 2/3 of final grade. The students' qualifications are tested through: a) results of every exercise, b) course journal with deadline for submission 3 weeks after the end of the laboratory course. Student's theoretical knowledge and understanding are tested by a final oral examination, with an external examiner present. The journal must be approved before one can take the final examination.

BIO320 Development Biology

Development Biology

Credits: 5 **Language:** English upon request
Staff/institute: Hilde-Gunn Opsahl Sorteberg/ IPM
Teachers: Stein Erik Lid.
Start term: Spring parallel
Terms: Spring parallel
The course is offered: Odd years
Mandatory activities: Presentation of one's own semester assignment and the presentation of the other semester assignments (students must be present at at least 50% of the presentations).
Prerequisites: BIO220 (GN200).
Type of course: 12 lectures, the writing and presentation of own semester assignment, and attending 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 goals: 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 **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%.

BIO321 Population Genetics and Molecular Evolution

Population Genetics and Molecular Evolution

Credits: 10 **Language:** English upon request
Staff/institute: Odd Arne Rognli/ IPM
Start term: Autumn parallel
Terms: Autumn parallel
Mandatory activities: Written reports of selected exercises have to be handed in for evaluation and be approved before the examination can be taken.
Prerequisites: BIO120-Introduction to Genetics, MATH010/MATH100-Introductory Mathematics, STAT100-Statistics.
Type of course: Lectures: 2 hours per week for 12 weeks. Arithmetic exercises/study groups: 3 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 goals: 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: Final Written exam **Grading:** A-F
Assessment methods: Written examination.
Examination aids: Any calculator, any other examination aids

BIO322 Molecular Genomics

Molecular Genomics

Credits: 10 **Language:** English upon request
Staff/institute: Dag Inge Våge/ IHA
Teachers: Sigbjørn Lien (IHA), Odd Arne Rognli (IPM).
Start term: Autumn parallel
Terms: Autumn parallel
Prerequisites: BIO210/211, BIO220 or HFM200
Type of course: Weeks 36-49: Lectures/Presentations of review papers prepared and given by the students.
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 term.
Learning goals: 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.
Methods of examination: Continous assessment **Grading:** A-F
Assessment methods: The written exam counts 2/3, the term project counts 1/3. The term project is evaluated by the supervisor through a written report, and there is a final evaluation simultaneously with the final written exam.

BIO330 Environmental Microbiology

Environmental Microbiology

Credits: 10 **Language:** English upon request
Staff/institute: Åsa Helena Frostegård/ IKBM
Teachers: Rolf Arnt Olsen, Lars Bakken
Start term: Spring parallel
Terms: Spring parallel
Mandatory activities: 10 seminars (2 hours each). Must attend at least 8 of the 10 seminars.
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 goals: 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 **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.

BIO331 Environmental Microbiology with Term Paper

Environmental Microbiology with Term Paper

Credits: 5 **Language:** English upon request
Staff/institute: Åsa Helena Frostegård/ IKBM
Teachers: Rolf Arnt Olsen, Lars Bakken
Last time the course is offered: VÅR
Start term: June block
Terms: June block
Prerequisites: Environmental Microbiology equivalent to BIO330.
Type of course: The students should start choosing the literature during the spring parallel. The block period is free to be used in the best possible way. Work on finding literature and individual study equals 150 hours.
Contents: The emphasis of the course is on collecting and reading relevant literature from scientific databases and libraries, and to summarise this in a written report. The topic for the report should be chosen within the field of environmental microbiology/microbial ecology. The title for the report should be decided during the spring term (period 4) after consulting the teachers responsible for the course BIO330 (Environmental Microbiology). Students will present their own projects orally before submitting them.
Learning goals: Students will practice searching and read scientific literature related to a selected topic within the field of environmental microbiology, and summarise this in a written report.
Methods of examination: Continous assessment **Grading:** A-F
Assessment methods: Written report and oral presentation. The written report should be delivered by the end of period 5 (June block).

BIO332 Experimental Microbiology

Experimental Microbiology

Credits: 10 **Language:** English upon request
Staff/institute: Åsa Helena Frostegård/ IKBM
Teachers: Sigve Håvarstein, Louise Kausmally
Start term: January block
Terms: January block Spring parallel
Mandatory activities: Seminars and laboratory exercises.
Prerequisites: Basic Microbiology equivalent to BIO130, Microbial Physiology, Genetics, and Systematics equivalent to BIO230.
Type of course: 6 lectures: 2 hours each. 6 seminars: 1 hour each Full day laboratory exercises for three weeks. Shorter lectures in connection with the exercises.
Contents: The course is an intensive laboratory course during weeks 2-5. 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 biological diversity in various ecosystems - characterisation and identification of bacteria - horizontal gene transfer - genetic regulation. Interpretation of results and discussions on the various methods.
Learning goals: The students will get 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.
Methods of examination: Continous assessment **Grading:** Pass/Fail

BIO333 Mycology

Mycology

Credits: 10 **Language:** English upon request
Staff/institute: Rolf Arnt Olsen/ IKBM
Teachers: Arne Tronsmo, 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 experimental work.
Prerequisites: General microbiology equivalent to BIO130. General genetics equivalent to BIO120. Microbial physiology equivalent to BIO230.
Type of course: Lectures: 4 hours per week. Seminars or experimental work: 2 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 goals: 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 and knowledge of the production of mushrooms for consumption. The students should be able to consider possible positive and negative effects of fungi, and suggest actions to limit any possible risks.
Methods of examination: Continous assessment **Grading:** A-F
Assessment methods: 4/10 from continuous evaluation of performance during the seminars and report from the experimental work, and 6/10 from the oral exam.

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: Compulsory participation in lectures.
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 evaluation and ethical considerations 3: Ethics and ethical evaluations. During the rest of the course, the students are to write a term paper on an independently chosen topic.
Learning goals: Students are to be familiar with the legislation in the field and who the central participants that researchers need to take into consideration in this connection are. 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 **Grading:** Pass/Fail
Assessment methods: Semester assignment

BIO420 Advanced Developmental Biology

Advanced Developmental Biology

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

Staff/institute: Hilde-Gunn Opsahl Sorteberg/ IPM
Teachers: Odd-Arne Olsen.
First time the course is offered: SPRING
Start term: Spring parallel
Terms: Spring parallel
The course is offered: Odd years
Mandatory activities: Presentation of semester assignments (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 goals: 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 **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 upon request
Staff/institute: Odd Arne Rognli/ IPM
Start term: Autumn parallel
Terms: Autumn parallel
Mandatory activities: The semester assignment must be handed in and approved before the examination can be taken.
Prerequisites: BIO120-Introduction to Genetics, MATH010/MATH100-Introductory Mathematics, STAT100-Statistics.
Credit reduction: Credit reduction in proportion to BIO321: 10 credits.
Type of course: Lectures: 2 hours per week for 12 weeks. Math exercises/study groups: 3 hours per week for 12 weeks. Presentation and discussion of semester assignment: 1 hour.
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 goals: 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: Final Written exam **Grading:** A-F
Assessment methods: Written examination.

Examination aids: Any calculator, any other examination aids

BOT230 Plant Ecology

Plant Ecology

Credits: 10 **Language:** English upon request
Staff/institute: Ørjan Totland/ INA
Teachers: Stein Joar Hegland (stein.hegland@umb.no)
Start term: August block
Terms: August block Autumn parallel
Mandatory activities: Participation in the August semester and hand-in of field reports.
Prerequisites: BOT100 and ECOL100
Type of course: Demonstrations/lectures in the field: 40 hours Lectures: 40 hours
Contents: Field demonstrations, field teaching, independent field work exercises, lectures, colloquia, semester assignment.
Learning goals: 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 that this has for the reproduction, nutrient uptake, life-history strategies, anti-herbivore defence, population dynamics and distribution of plants, and for the structure of plant communities. The main part of the course takes place in the field and gives students good insight into the integration between ecological theory and field methodology. The course gives students a solid foundation of knowledge which is useful in further studies in ecology and nature management and also relevant to students in other plant-related disciplines.
Methods of examination: Continous assessment **Grading:** A-F
Assessment methods: Written exam, 3.5 hours, counts 3/5 of the grade. Semester assignment counts 2/5 of the grade.

BOT310 Advanced Taxonomy of Plants

Advanced Taxonomy of Plants

Credits: 10 **Language:** English upon request
Staff/institute: Kåre Lye/ INA
Start term: Autumn parallel
Terms: Autumn parallel
The course is offered: Even years
Prerequisites: BOT220
Type of course: Lectures: 24 hours. Some of these hours will be used for seminars where the students will present their semester assignments. Additionally, there will be some voluntary evening excursions and laboratory exercises.
Contents: The students are to be given an introduction to classical and modern methods in taxonomy and subject disciplines related to taxonomy and gain insight into the research that is being done on the field. In pure taxonomy, the emphasis is placed on being able to identify the most important families that plants belong to, both when it comes to national species and internationally important species. Here the student is to specialize in a specific family. Other topics that will be lectured on are the rules of nomenclature and the use of Latin, as well as herbarium technique. The course will also include some voluntary, more practical excursions to the botanical garden in Oslo and to some important key isotopes.
Learning goals: Knowledge of taxonomy and floristics is to make the students better suited for conducting research and teaching work in this field, as well as making it easier for students to understand and work with nature protection, ecology and vegetation mapping. Students who have completed the course will also be familiar with different types of biodiversity and be able to carry out measurements of biodiversity for municipalities and others themselves.
Methods of examination: Continous assessment **Grading:** A-F
Assessment methods: Oral exam counts 50%. Semester assignment counts 50%.

BOT320 Advanced Course in Plant Development Physiology

Advanced Course in Plant Development Physiology

Credits: 15 **Language:** English

Staff/institute: Christiaan Van Der Schoot/ IPM
Start term: Spring parallel
Terms: Spring parallel
Mandatory activities: Approved lab reports and a seminar on 1-2 recent scientific publications.
Prerequisites: BOT200.
Type of course: Lectures: 20 hours. Colloquia: 12 hours. Lab classes: 60 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. The course includes lectures, lab classes and colloquia.
Learning goals: The course provides opportunities to develop skills and 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 experimentation as well as in presenting and discussing experimental and theoretical results.
Methods of examination: Continous assessment **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.

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 placed 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 goals: 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 placed 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 interests and needs of the students.
Methods of examination: Continous assessment **Grading:** A-F
Assessment methods: The oral exam of 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 oral presentation, a poster and a scientific article.

BOT350 Pollination and Reproductive Ecology of Plants

Pollination and Reproductive Ecology of Plants

Credits: 5 **Language:** English upon request
Staff/institute: Ørjan Totland/ INA
Start term: Autumn parallel
Terms: Autumn parallel
Prerequisites: BOT230, ECOL200
Type of course: Lectures: 14 hours Colloquia: 14 hours

Contents: Lectures, colloquia, semester assignment. Field demonstrations if possible.
Learning goals: The course gives advanced knowledge of the pollination and reproductive ecology of plants. There will be special focus on: adaptations to various pollen vectors, pollinator behaviour, pollination limitation to reproduction, natural selection of pollination traits, evolution of pollination adaptations, the connection between pollination and reproductive strategies, the evolution of reproductive strategies, and management. The course makes students capable of doing Master's and PhD degrees on the pollination and reproductive ecology of plants, and gives students with Master's degrees in other plant sciences useful additional knowledge for their projects. The course is problem-based and provides the students with critical attitudes towards the existing knowledge within the field.
Methods of examination: Continous assessment **Grading:** A-F
Assessment methods: Oral exam counts 3/5 of the grade and semester assignment counts 2/5 of the grade.

BUS230 Management Science-Principles

Management Science-Principles

Credits: 10 **Language:** English upon request
Staff/institute: Marie Steen/ IØR
Teachers: Teaching assistants.
Start term: Spring parallel
Terms: Spring parallel
Mandatory activities: Compulsory home assignments. The home assignments are valid for up to 2 years after approval.
Prerequisites: Introductory courses in mathematics, statistics and microeconomics.
Credit reduction: BUS231-10 credits, BUS232-5 credits.
Type of course: Lectures: 3 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. Relationship to other courses: The Master;s level courses BUS330 and ECN350 require knowledge in Decision modelling.
Learning goals: 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 formulation and solution of 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: Written final exam, 100%. External examiner in accordance with applicable regulations.
Examination aids: Simple calculator, no other examination aids

BUS231 Decision Modelling -Principles

Decision Modelling -Principles

Credits: 10 **Language:** English
Staff/institute: Marie Steen/ IØR
Teachers: Teaching assistants.
Start term: Spring parallel
Terms: Spring parallel
Mandatory activities: Compulsory home assignments. The home assignments are valid for up to 2 years after approval.
Prerequisites: Introductory courses in mathematics, statistics and microeconomic theory.
Credit reduction: BUS230-10 credits, BUS232-5 credits.
Type of course: 3 hours of lectures and 2 hours in the computer lab per week.
Contents: Introduction to models and modelling, spreadsheet modelling, linear programming, integer programming, network models, non-linear programming, multi-objective programming. Relationship to other courses: The Master's level courses BUS330 and ECN350 require knowledge in Decision modelling.
Learning goals: The course shall give the students a solid basis for the use of important quantitative decision methods, where linear programming is the most important, to analyse economic and business problems. The main emphasis in the course will

be put on formulating and solving different types of problems. Furthermore, the economic interpretations of the results are central. The importance of the strengths and weaknesses of the different methods will be discussed, as well as the fact that a model will always be a limited representation of reality. The course will to a certain degree be aimed towards agriculture and resource management problems.
Methods of examination: Final Written exam **Grading:** A-F
Assessment methods: Final written exam, 100 %. External examiner in accordance with applicable regulations.
Examination aids: Simple calculator, no other examination aids

BUS232 Decision Modelling-Fundamentals

Decision Modelling-Fundamentals

Credits: 5 **Language:** English
Staff/institute: Marie Steen/ IØR
Teachers: Teaching assistants.
Start term: Spring parallel
Terms: Spring parallel
Mandatory activities: Compulsory home assignments. The home assignments are valid for up to 2 years after approval.
Prerequisites: Introductory courses in mathematics, statistics and microeconomic theory.
Credit reduction: BUS230-5 credits, BUS231-5 credits.
Type of course: 3 hours of lectures and 2 hours in the computer lab per week.
Contents: Introduction to models and modelling, spreadsheet modelling, linear programming, multi-objective programming. Relationship to other courses: The Master's level courses BUS330 and ECN350 require knowledge in Decision modelling.
Learning goals: The course shall give the students a basis for the use of important quantitative decision methods, where linear programming is the most important, to analyse economic and business problems. The main emphasis in the course will be put on formulating and solving different types of problems. Furthermore, the economic interpretations of the results are central. The importance of the strengths and weaknesses of the different methods will be discussed, as well as the fact that a model will always be a limited representation of reality. The course will to a certain degree be aimed towards agriculture and resource management problems.
Methods of examination: Final Written exam **Grading:** A-F
Assessment methods: Final written exam. 100%. External examiner in accordance with applicable regulations.
Examination aids: Simple calculator, no other examination aids

ECN111 Introduction to Economics-Micro

Introduction to Economics-Micro

Credits: 5 **Language:** English
Staff/institute: Sigurd Rysstad/ IØR
Teachers: Different teachers.
First time the course is offered: SPRING
Start term: Spring parallel
Terms: Spring parallel
Prerequisites: Higher education entrance qualification, in Norway.
Credit reduction: ECN110 -5 ECTS.
Type of course: Lectures: 28 hrs. Exercises: 28 hrs. Reading literature etc.: 94 hrs.
Contents: The course consists of the following subjects: The behaviour of the consumer. The behaviour of the producer. Different markets, especially free competition and monopoly. Welfare theory, especially about market success and failure.
Learning goals: The course is an introductory course. Students should learn principles of the theory of microeconomics. More specifically, the aim of the course is to give the students (i) an overview over the most important concepts and models in microeconomics, ii) the first training to formulate and solve microeconomic problems and (iii) good qualifications for further studies in economics.
Methods of examination: Final Written exam **Grading:** A-F
Assessment methods: Final written exam, 3.5 hours.

Examination aids: No calculator, no other examination aids

ECN121 Introduction to Economics-Macro

Introduction to Economics-Macro

Credits: 5 **Language:** English
Staff/institute: Per Halvor Vale/ IØR
Teachers: Per Halvor Vale.
First time the course is offered: AUTUMN
Start term: Autumn parallel
Terms: Autumn parallel
Prerequisites: Higher education entrance qualification in Norway and ECN111 (Introduction to economics, micro).
Credit reduction: ECN120-100%.
Type of course: Lectures: 2 hours per week. Exercises: 2 hours per week.
Contents: Part 1: Free market economic theory, 2 weeks. Part 2: Macroeconomics, 12 weeks.
Learning goals: The student is to gain the knowledge needed to take a medium-level course in macroeconomics in Norway or abroad. Students should be able to apply simple macroeconomic planning models to questions regarding full employment, internal and external balance in the economy etc., and understand how the use of fiscal and monetary policy effect the economy. After the course has been completed, students should be familiar with the main points in the discussion of welfare theory and market economic theory. The students should i) learn economic concepts and ideas. ii) be trained in logical reasoning. iii) be given some training in the application of mathematics. iv) learn to see the difference between case and person in discussions. v) get an academic attitude, i.e. that the opinions are based on knowledge and logical thinking.
Methods of examination: Final Written exam **Grading:** A-F
Assessment methods: Written 3.5 hours.
Examination aids: Simple calculator, no other examination aids

ECN150 Introduction to Development Economics

Introduction to Development Economics

Credits: 5 **Language:** English upon request
Staff/institute: Carl Erik Schulz/ IØR
Teachers: Arild Angelsen, Stein Holden.
Start term: Spring parallel
Terms: Spring parallel
Mandatory activities: Writing and presentation of one semester assignment. This paper and presentation will not be graded.
Prerequisites: ECN110 or ECN111.
Type of course: Lectures: 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 goals: 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 hour written exam.
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
Prerequisites: Mathematics (MAT100), statistics (STAT100), and microeconomics (ECN210/ECN212).
Credit reduction: The course covers the material in the Norwegian version of the course-ECN200-which was given for the last time in 2004. The course partly overlaps with ECN202 and STAT200. There is reduction in credits for these courses; ECN200 (10 credits), 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 semester assignment.
Learning goals: 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 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 **Grading:** A-F
Assessment methods: The final grade will be based upon a written exam and a semester assignment. A 3.5 hour written exam will count 50 %. The semester assignment will count 50 %. Both the written exam and the semester assignment must receive a passing grade for passing the course. If you fail in one part, you fail the course. The deadline for the semester assignment will be set at the beginning of the course.

ECN212 Microeconomics

Microeconomics

Credits: 5 **Language:** English
Staff/institute: Sigurd Rysstad/ IØR
Start term: August block
Terms: August block
Prerequisites: A basic course in calculus.
Credit reduction: ECN210-5 credits.
Type of course: Week 33, 34 and 35: 4 hours of lectures and exercises per day.
Contents: - Theory of the consumer. - Theory of the producer. - Market structures. - Welfare theory.
Learning goals: The students should, after passing this course, master microeconomics at an intermediate level. The emphasis is on providing an intuitive understanding of the basic concepts and models, as well as formulating and solving problems graphically and mathematically.
Methods of examination: Final Written exam **Grading:** A-F
Assessment methods: Final written exam (100%).
Examination aids: Simple calculator, no other examination aids

ECN213 Industrial Organisation

Industrial Organisation

Credits: 5 **Language:** English upon request
Staff/institute: Olvar Bergland/ IØR
Start term: January block
Terms: January block
Mandatory activities: Exercises must be approved. Participation in study groups.

Prerequisites: Microeconomics (ECN212 or ECN210).
Type of course: Lectures: ca. 24 hours. In addition, there will be study-group work and organized review of exercises.
Contents: Topics: Competition and market power. Monopoly, dominant firms and product quality. Price discrimination. Oligopoly and cartels. Market power and strategic behaviour. Natural monopolies and regulation. The course emphasises the use of game theory and strategic behaviour in understanding non-price competition in markets.
Learning goals: The knowledge and tools needed to be able to understand and analyse market adaptation, market structure and market power, and the interaction between competition conditions and strategic behaviour in the market. Natural monopolies and regulation.
Methods of examination: Final Oral exam **Grading:** A-F
Assessment methods: Oral exam. Exercises and participation in group work and discussions will be used for formative assessment.

ECN230 International Economics

International Economics

Credits: 5 **Language:** English
Staff/institute: Roberto J. Garcia/ IØR
Start term: Autumn parallel
Terms: Autumn parallel
Mandatory activities: Exercises.
Prerequisites: Basic knowledge in macro- and microeconomics ECN120, ECN220 and ECN210.
Type of course: 4 hours per week.
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 goals: 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 exam.
Examination aids: No calculator, no other examination aids

ECN251 Development Economics-Micro

Development Economics-Micro

Credits: 5 **Language:** English
Staff/institute: Carl Erik Schulz/ IØR
Start term: Spring parallel
Terms: Spring parallel
Mandatory activities: Compulsory assignments.
Prerequisites: ECN212 Microeconomics or ECN210 Microeconomics I.
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 is divided into two parts. In the first we study the economics of farm households. We especially emphasise the difference between farm-household economics and conventional economics of the firm. In the second part we study rural organisations (institutions), including market and non-market institutions.
Learning goals: 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 than the behaviour of firms and markets in developed countries.
Methods of examination: Continous assessment **Grading:** A-F

Assessment methods: A 24 hours take-home exam counts for 100 percent of the final grade. This examination arrangement might be changed.

ECN270 Resource and Environmental Economics

Resource and Environmental Economics

Credits: 10 **Language:** English
Staff/institute: Ragnar A. Øygard/ IØR
Teachers: Arild Vatn, Arild Angelsen, Ståle Navrud.
Start term: Autumn parallel
Terms: Autumn parallel
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: 4 hours lectures per week, plus up to 2 hours seminars and exercise review per week.
Contents: Lectures and exercises will address the following issues: Welfare theory, 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, institutional theory in environment and natural resource management. The course will emphasise issues, cases and perspectives of particular relevance to developing countries.
Learning goals: 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: Continous assessment **Grading:** A-F
Assessment methods: Five exercises: 30 %. Final written exam, 3 hours: 70 %.

ECN271 Project Evaluation and Environmental Valuation

Project Evaluation and Environmental Valuation

Credits: 10 **Language:** English upon request
Staff/institute: Ståle Navrud/ IØR
Teachers: Arild Vatn.
Start term: Spring parallel
Terms: Spring parallel
Prerequisites: ECN170 (or ECN270), ECN210 and ECN202 (or ECN201); or similar introductory courses in environmental and resource economics, econometrics and microeconomics.
Type of course: 60 hours.
Contents: The course gives an overview of theory and methods for project evaluation, with emphasis on cost-benefit analyses (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 noise and other impacts from road construction projects, air and water pollution, landscape aesthetics, biodiversity, recreation, hydro power development, 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, the welfare theoretic basis for CBA and the value judgements/assumptions made in CBA. The eight steps of CBA, with special emphasis on risk/uncertainty, distributional impacts, valuation of environmental impacts, and treatment/presentation of non-valued impacts. Theory, method and an application of Multi Criteria Analysis, as an alternative to CBA, will also be presented.
Learning goals: 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 valuation of environmental impacts, health impacts and impacts on cultural heritage. They should also be able to interpret and evaluate Multi-Criteria Analyses (MCAs), as an alternative approach to CBA.
Methods of examination: Final **Grading:** A-F

Assessment methods: A semester assignment, which is prepared by groups of 3-4 students. In the semester assignments the students will apply what they have learned about theory and methods on 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.

ECN300 Applied Econometrics

Applied Econometrics

Credits: 10 **Language:** English
Staff/institute: Olvar Bergland/ IØR
Start term: Autumn parallel
Terms: Autumn parallel
Prerequisites: Econometrics (ECN201) (or regression analysis), intermediate microeconomics, statistics and calculus.
Type of course: 6 hours of classroom lectures, pc-laboratory exercises and group discussions weekly. (The composition varies during the semester.)
Contents: The emphasis is on modern econometric techniques applied to survey data (both cross-sectional and panel data). The following topics will be covered: linear regression models with stochastic and endogenous regressors panel data models with unobserved heterogeneity and limited dependent variable models (logit/probit, interval regressions, censoring and truncation).
Learning goals: The students should be able to do independent econometric and statistical modelling with current techniques in applied economic research.
Methods of examination: Continous assessment **Grading:** A-F
Assessment methods: Final written exam (3 hours) 60% and home assignments(40%).

ECN310 Market Analysis

Market Analysis

Credits: 15 **Language:** English
Staff/institute: Kyrre Rickertsen/ IØR
Teachers: Frode Alfnes.
Start term: Autumn parallel
Terms: Autumn parallel
Mandatory activities: Eight problem sets must be graded as passed before taking the exam.
Prerequisites: Econometrics on the level of ECN201, statistics, mathematics, and microeconomics.
Type of course: There are eight hours of lectures and exercises per week. On average, six hours will be lectures and two hours will be exercises.
Contents: The course covers the material in Gujarati's textbook that was not covered in ECN201 (or ECN200) and the duality theory that was not covered in the intermediate courses in microeconomics. The lectures in ECN310 cover: constrained and unconstrained optimisation, the theory of the consumer, the theory of the firm, simultaneous-equation models and methods, qualitative response regression models, dynamic econometric models, time series econometrics, and applied market analysis.
Learning goals: ECN310 develops the theory and methods introduced in intermediate courses in microeconomic theory and econometrics. The course gives the students a basic training in analysing markets. Factors affecting supply, demand, and input demand are studied. How to estimate the effects of these factors are also important in this course. The focus is on applying existing theory and methods and not on proving them. The students have to perform their own analysis and write a semester assignment. The course literature provides a basis for reading and understanding articles in scientific journals dealing with applied market analysis.
Methods of examination: Continous assessment **Grading:** A-F
Assessment methods: The final grades will be set on basis of a written exam and a semester assignment. A 3.5 hour written exam will count 50 % and the semester assignment will count 50 %. Both the written exam and the semester assignment must receive a passing grade for passing the course. If you fail in one part, you fail in the course. The deadline for the semester assignment will be set at the beginning of the course.

ECN330 Commodities and International Economics

Commodities and International Economics

Credits: 15 **Language:** English
Staff/institute: Roberto J. Garcia/ IØR
Start term: August block
Terms: August block Autumn parallel
Mandatory activities: Six exercises.
Prerequisites: Microeconomics, International Economics, Econometrics ECN211/ECN212, ECN230, ECN200/ECN201.
Credit reduction: ECN331: 5 credits.
Type of course: August block: 15-20 lecture/class hours. Autumn parallel: 6 hours per week; 40 hours total.
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 goals: Students are expected to develop: · an appreciation for the complex interrelationships between the foreign exchange market and the money, goods, and capital markets; · an understanding of the implications of a government's macroeconomic policy under a fixed, flexible, and managed foreign exchange regime and the economic implications of the policy choice; · a conceptual framework for understanding the economic implications of regional integration versus the WTO's multilateral trading system; and · the ability to assess trade policies and 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 **Grading:** A-F
Assessment methods: Mid-semester written exam, 30%. Final written exam, 3.5 hours, 40%. Oral exam, 30%.

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: Exercises.
Prerequisites: ECN230.
Credit reduction: ECN330: 5 credits.
Type of course: 15-20 lectures and exercise lessons.
Contents: - Balance of payment and economic policy.-Markets for foreign exchange.-Capital markets.-International economic policy.-Growth and development.
Learning goals: Give the students an introduction to economic policy in open economies, and to the functioning of capital markets.
Methods of examination: Final Written exam **Grading:** A-F
Assessment methods: Written exam, 3.5 hours.
Examination aids: No calculator, no other examination aids

ECN350 Development and Environment Economics

Development and Environment Economics

Credits: 15 **Language:** English
Staff/institute: Stein Terje Holden/ IØR
Teachers: Arild Angelsen.

Start term: Autumn parallel
Terms: Autumn parallel
Mandatory activities: Compulsory exercises. Group work/presentations.
Prerequisites: Basic knowledge in economic theory (micro economics, macro economics, development economics, resource economics, econometrics, operations research. ECN200/201, ECN230, ECN251, ECN270.
Credit reduction: ECN450, 15 credits.
Type of course: Lectures: 4-6 hours per week. Exercises: 2-4 hours per week. Total: 8 hours per week (lectures and exercises).
Contents: 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.-Policies for poverty reduction. Environment and development:-Market imperfections and the environment.-Poverty and land degradation.-Population, agriculture and deforestation.
Learning goals: 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: Continous assessment **Grading:** A-F
Assessment methods: Written exam (3.5 hours): 50%. Oral exam: 50%. The students have a number of compulsory computer exercises to submit individually (80% has to be submitted and approved in order to be able to take the exams). Participation in group exercises/presentations is compulsory.

ECN351 Research in Development Economics

Research in Development Economics

Credits: 5 **Language:** English
Staff/institute: Carl Erik Schulz/ IØR
Teachers: Arild Angelsen, Stein Holden.
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 ECN211 Microeconomics II and ECN220 Economics II, ECN200 Econometrics or ECN201 Econometrics.
Credit reduction: It is not possible to earn credits for both ECN351 and previous ECN250, as these courses overlap considerably.
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 researchable research questions; - How to write a thesis and research proposal; - General writing rules; - Field research methods; - Social surveys, including sampling, surveys and analysis; - Impact studies; and - Introduction to the STATA statistical package.
Learning goals: 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 **Grading:** Pass/Fail
Assessment methods: The semester assignment (research proposal) is due late March, and will count for 100 percent of the final grade.

ECN352 Development Economics-Macro

Development Economics-Macro

Credits: 10 **Language:** English
Staff/institute: Ragnar A. Øygard/ IØR

Start term: Spring parallel
Terms: Spring parallel
Prerequisites: Basic micro- and macroeconomic theory, e.g., ECN120, and preferably also ECN210 and ECN220.
Credit reduction: ECN252: 10 credits.
Type of course: The course will have 6 class hours per week, of which approx. 4 hours will be used for lecturing and approx. 2 hours for other activities.
Contents: The topic of the course covers a very wide area. In order to concentrate on a few topics and theories, and to avoid overlap with other courses, the course will have two main parts. The first (and largest) part deals with economic growth and development-the long-term perspective, and the second one with macroeconomics theories of economic stabilisation and management-the short/medium-term perspective. A significant share will be spent to discuss economic growth and macroeconomic policies in relation to environmental and poverty/distributional issues. Key topics of the course include: I. Economic growth (the long term perspective) - Historical overview; growth vs. development - Old Growth theories (Harrod Domar and Solow) - New growth theories (endogenous growth) - Economic growth and institutions - The growth record: Asia vs. Africa - Growth, inequality and poverty - Growth, poverty and development aid - Poverty reduction strategies and economic policies - Growth and the environment - Growth and agriculture - Growth and population II. Macroeconomic management (the short/medium-term perspective) - Closed economy models (ISLM, ADAS) - Open economy models (Mundell Fleming) - Current stabilisation and structural problems (e.g. financial crisis)
Learning goals: 1. To acquire knowledge about major theories and models of economic growth/development and macroeconomic management in developing countries. 2. To be able to apply these theories and models to understand and critically analyse current development, macroeconomic and global economic issues, as well as particular policies and programmes in developing countries.
Methods of examination: Continous assessment **Grading:** A-F
Assessment methods: The final grade will be based on: (i) two individual assignments (10 % each), (ii) an individual class presentation (10 %), (iii) a group work (10 %), (iv) a final, written exam (3 hours) (60 %).

ECN371 Environmental Economics

Environmental Economics

Credits: 10 **Language:** English upon request
Staff/institute: Arild Vatn/ IØR
Teachers: Eirik Romstad and Arild Vatn.
Start term: Spring parallel
Terms: Spring parallel
Mandatory activities: Seminars with presentations.
Prerequisites: Resource economics courses at the intermediate level, ECN271 and ECN273 or ECN270.
Credit reduction: ECN370: 10 credits.
Type of course: 46 hours, together with considerable guidance in connection with group assignments. 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) Producing a semester paper. Part B will cover topics such as climate regulation, pollution from industry and agriculture, management of common goods (i.e. landscape goods, biodiversity, etc.). For part C, there will be an even wider selection of topics for the students to choose from. These are adjusted to conditions in developing countries as well.
Learning goals: The students shall acquire insights about 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: Continous assessment **Grading:** A-F
Assessment methods: Group semester assignment (50%) and written exam, 3 hours (50%).

ECN373 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.
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 goals: 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: Continous assessment **Grading:** A-F
Assessment methods: The semester assignment counts 100 % of the grade.

ECN374 Natural Resource Economics

Natural Resource Economics

Credits: 10 **Language:** English
Staff/institute: Olvar Bergland/ IØR
Start term: Autumn parallel
Terms: Autumn parallel
Prerequisites: Intermediate microeconomics; finance and investment theory; statistics; resource economics; and environmental valuation.
Credit reduction: ECN272: 10 credits.
Type of course: 4 hours of class-room lectures and group discussions weekly.
Contents: The following topics will be covered: Natural resources as capital; economic rent; allocation of resources over time; cost-benefit analysis; uncertainty; option value; allocation of land; allocation of renewable resources; allocation of non-renewable resources; extraction and exploration; price uncertainty; biological uncertainty; irreversibility; economic growth and sustainable development.

Learning goals: The students should understand key concepts, models and results used and found in natural resource economics. They should be able to utilise economic theory and models for the analysis of efficient resource utilisation over time, both without and with uncertainty.
Methods of examination: Continous assessment **Grading:** A-F
Assessment methods: The compulsory home assignments count 30% and the final oral exam counts 70% of the course grade.

ECN380 Energy Economics II

Energy Economics II

Credits: 10 **Language:** English upon request
Staff/institute: Olvar Bergland/ IØR
Teachers: Torstein Bye, Ole Gjølberg.
Start term: Autumn parallel
Terms: Autumn parallel
Mandatory activities: Participation in study groups.
Prerequisites: BUS220, BUS230, BUS330, ECN201/ECN202, ECN213, ECN271, ECN280.
Type of course: Thematic lectures will be given, with subsequent study group work (Approximately 60 hours).
Contents: The topic covers central questions concerning risk management, market regulation, economic analysis of energy projects and the energy sector.
Learning goals: 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: Continous assessment **Grading:** A-F
Assessment methods: The semester assignment counts 50 % and the oral exam counts 50 %. Assessment of the semester assignment with feedback will take place during the course. There will be a final assessment of the semester assignment and the oral exam.

ECN450 Development Economics: Methods and Policy Analysis

Development Economics: Methods and Policy Analysis

Credits: 20 **Language:** English
Staff/institute: Stein Terje Holden/ IØR
Teachers: Arild Angelsen.
Start term: Autumn parallel
Terms: Autumn parallel January block
Mandatory activities: Exercises, group work, presentations.
Prerequisites: Master's degree in Economics or Agricultural Economics.
Credit reduction: ECN350-15 credits.
Type of course: Lectures: 4-6 hours per week. Exercises: 2-4 hours per week.
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.-Policies for poverty reduction. Environment and development.-Market imperfections and the environment.-Poverty and land degradation.-Population, agriculture and deforestation.
Learning goals: Application of economic theory and methodology on development policy issues in developing countries. Combination of theory and methodology. Use of computer/software tools for policy analysis. Training in scientific writing.
Methods of examination: Continous assessment **Grading:** A-F
Assessment methods: Written exam: 1/3, Oral exam: 1/3, Paper: 1/3. Written exam joint with ECN350.

ECN451 Institutions, Property Rights and Development

Institutions, Property Rights and Development

Credits: 10 **Language:** English
Staff/institute: Arild Angelsen/ IØR
Start term: Spring parallel
Terms: August block Autumn parallel Spring parallel
The course is offered: Other - The course is given in years with even number, given sufficient interest.Emnet gis annet hvert år (2006, 2008 etc.), dersom det er nok påmeldte studenter.
Mandatory activities: Class presentation.
Prerequisites: Intermediate knowledge of microeconomic theory, including basic game theory and farm household models.
Type of course: Six hours per week, divided between lecturing and student presentations. The classes will last for 5-6 weeks, the rest of the time is for self-study and writing of semester assignment. The course will be given during the spring semester, but the timing will be agreed on by students based on their preferences.
Contents: The course is, firstly, about institutional change: how do institutions emerge and change? The focus is on one particular set of institution, namely property rights, and more specifically property rights which govern the use of natural resources in developing countries. Secondly, the course looks into how property rights affect decisions regarding input use, investments, and use/management of natural resources. The course consists of six parts: 1. Introduction: Historical overview of the field, definitions of institutions, and the role of institutions in economic development. 2. Theories on the evolution of property rights. 3. Case studies of the evolution of individualised property rights, land reforms and the impact on resource management. Research methods. 4. A game-theoretic approach to collective action and common property resource management (CPRM). 5. Applications and cases of CPRM. Research methods. 6. Presentation and discussion of ideas for the semester assignment.
Learning goals: (1) To get an understanding and be able to critically analyse: (i) how institutions evolve and change, and (ii) how institutions determine economic behaviour and management of natural resources, with particular emphasis on property rights in developing countries. (2) To be able to do own research on institutional issues based on current theories and methodologies.
Methods of examination: Continous assessment **Grading:** Pass/Fail
Assessment methods: Semester assignment (100 %). The students have to write a scientific paper (7-9000 words), preferably in relation to their PhD thesis.

ECN453 Topics in Development Economics

Topics in Development Economics

Credits: 10 **Language:** English
Staff/institute: Stein Terje Holden/ IØR
Teachers: Arild Angelsen.
Start term: Spring parallel
Terms: Spring parallel
The course is offered: By assignment
Type of course: 2 hours of lecturing per week.
Contents: Topics and literature will vary from year to year.
Learning goals: 1. To get deeper insights into key areas of development economics. 2. To be able to actively use the theories and methodologies in own research.
Methods of examination: Continous assessment **Grading:** A-F
Assessment methods: The exam consists of a home exam/semester assignment.

ECOL110 Tropical Ecology and Biology

Tropical Ecology and Biology

Credits: 10 **Language:** English
Staff/institute: Stein Ragnar Moe/ INA
Teachers: Kari Klanderud, Jonathan Colman
First time the course is offered: AUTUMN
Start term: Autumn parallel
Terms: Autumn parallel

Mandatory activities: Field work, lab work, colloquia. Approved journals and papers.
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. 40 hours Lab work: ca. 20 hours Field course: ca. 30 hours Excursion: 1-2 days 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 goals: 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 plants and animals important 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: Final Written exam **Grading:** A-F
Assessment methods: Written examination of 3 hours.
Examination aids: No calculator, no other examination aids

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
Prerequisites: ECOL100, BOT100 and ZOOL100
Type of course: Lectures: 4 hours per week for 10 weeks = 40 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 are to read and study the syllabus through independent work and colloquia exercises.
Learning goals: 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: Continous assessment **Grading:** A-F
Assessment methods: A written examination (3 hours) at the end of the course accounts for 2/3 of the course grade. The quality of three written reports, which should be delivered during the course, accounts for 1/3 of the course grade.

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, BOT100 and ZOOL100
Type of course: Introductory lecture of 2 hours.

Contents: Independent study.
Learning goals: 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 **Grading:** A-F
Assessment methods: The course is evaluated based on one independent work (semester assignment).

ECOL250 Tropical Ecosystems and Biodiversity

Tropical Ecosystems and Biodiversity
Credits: 5 **Language:** English
Staff/institute: Jonathan Edward Colman/ INA
Teachers: Stein R. Moe
Start term: August block
Terms: August block
Mandatory activities: Seminars.
Prerequisites: ECOL200
Type of course: Lectures/seminars/colloquium: 2 hours per day.
Contents: The course introduces students to the major tropical biomes, providing key characteristics of each. Important ecological concepts will be introduced and explored within a tropical context. Key aspects of specific ecosystems, such as limiting factors, nutrient exchange, species interactions and human-community involvement will form the basis for the course. The students will write a semester assignment individually or in groups. The assignment forms the basis of the grade, and the course teacher will give supervision during the work.
Learning goals: The course provides the students with an understanding of key biological characteristics of tropical ecosystems and establish a foundation for higher-level studies in tropical ecology and natural resource management. The students should learn to identify unique characteristics of tropical biomes (e.g., desert, arid, grasslands, forests, mountain, coastal and aquatic systems) and understand complex ecological concepts applicable to them.
Methods of examination: Continous assessment **Grading:** A-F
Assessment methods: Semester assignment.

ECOL300 Ecological Scientific Methodology

Ecological Scientific Methodology
Credits: 5 **Language:** English upon request
Staff/institute: Svein Dale/ INA
Teachers: Geir Sonerud, Jon Swenson, Ørjan Totland
Start term: Spring parallel
Terms: Spring parallel
Mandatory activities: Exercises and group work that must be approved.
Prerequisites: Completed Bachelor degree and approved admission to Master degree programme in Ecology, Management of Natural Resources or Tropical Ecology and Manangement of Natural Resources.
Type of course: Lectures: 15-20 hours. Exercises/group work: 10-20 hours.
Contents: The different phases of the work with a Master's thesis will be covered in weekly lectures. Topics that require effort on the part of the students in the form of writing exercises, work on a computer to get to know the statistics programs etc, will be supported by exercises and/or group work where teachers are present or available. Towards the end of the course, the students will have a basis for working independently with the individual projects.

Learning goals: 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 is to give students a basic understanding of 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 is to 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 that are to be investigated, deduce predictions that are to be tested, plan how the data is to be collected in a representative and effective way, plan and conduct laboratory or field studies/experiments, process and insert data into computer programs, choose statistical analyses suitable for the data, interpret the statistical analyses , present the results in figures and tables, present, in a written form, the scientific study in the form of a Master's thesis with a summary, introduction, methods, results, discussion and references, present the material using precise, scientific formulation including scientific English, publish and distribute the Master's thesis. The course will also touch upon ethical questions related to research and give students advice on how to handle ethical problems in research.
Methods of examination: Continous assessment **Grading:** Pass/Fail
Assessment methods: Project assignment.

ECOL310 Global Change Ecology

Global Change Ecology

Credits: 10 **Language:** English upon request
Staff/institute: Mikael Ohlson/ INA
Start term: Autumn parallel
Terms: Autumn parallel
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 works on the topic, and every candidate must submit a written summary of the respective works. The contents of the works are presented and discussed in a seminar. The candidates will have the main responsibility for this presentation.
Learning goals: 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 is to be able to synthesise and acquire information from material 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 **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 regard presentation and discussion of original scientific publications, accounts for 2/5 of the course grade.

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
First time the course is offered: SPRING
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, exercise 30, excursions 100, student presentations 30, group work 50, project 80.
Contents: The course consists of a field course of 4 weeks in Tanzania. In the first few days there will be orientations and introductions. Then there will be 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 goals: The main goal is to give the students an understanding of how the complex connection between ecology, resource management, and culture sets limits and give 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 on going 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 **Grading:** A-F
Assessment methods: The students have to hand in their project reports for evaluation by May 15th.

ECOL350 Restoration Ecology

Restoration Ecology

Credits: 5 **Language:** English
Staff/institute: Jonathan Edward Colman/ INA
Teachers: Stein R. Moe
Start term: Spring parallel
Terms: Spring parallel
Mandatory activities: Short reports and presentations.
Prerequisites: ECOL250 and NATF320
Type of course: Lectures/seminars 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 couse will also place theses problem issues in an ecological and social context. In addition to focusing on restoration of ecosystem processes and characteristics, the course will deal with help measures in connection with larger infrastructure projects.
Learning goals: The goal of the course is to whow how degraded ecosystems may be redeveloped and become self-functioning systems once again.
Methods of examination: Continous assessment **Grading:** A-F
Assessment methods: Final written exam (3 hours) counts for 3/5 of the grade, semester assignment/reports count for 2/5 of the grade.

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), Bjørn Walseng (NINA), Tharan Fergus & Anja Skiple Ilbrek (NVE)
Start term: Spring parallel
Terms: Spring parallel
Mandatory activities: Field trip and laboratory work.
Prerequisites: 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 goals: The students should acquire good insight into 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 **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).

EDS105 Introduction to Development Studies

Introduction to Development Studies

Credits: 10 **Language:** English
Staff/institute: Knut G. Nustad/ Noragric
Teachers: A seminar instructor will participate.
Start term: August block
Terms: August block Autumn parallel
Mandatory activities: Attendance in at least 2/3 of seminars in the Autumn paralell and approved term paper.
Prerequisites: Students should have good English language skills.
Type of course: August block: 10 days of lectures, seminars and group work (2 days for each of five thematic focus areas). Autumn parallel: 24 hours of lectures, 24 hours of seminars.
Contents: The August block commences with a presentation of social and natural science approaches to development studies. This serves as both an introduction to the course and as a basis for choosing courses in the Autumn parallel. Teaching in the parallel consists of 12 lectures of 2 hours, and 12 seminars of 2 hours. Lectures are held by scientific staff from the involved departments. Seminars are led by a seminar instructor and consist of oral presentations and comments on the work of other students. Students will write a term paper and take a written exam. Individual feedback will be given on the term paper.
Learning goals: Students are provided with an interdisciplinary basis for further studies of development issues. The Bachelor programme in development studies includes both natural and social science approaches, and the course will therefore give students a basis in the different approaches and the major issues in development studies. Seminars will give students training in collecting, analysing and presenting information. Students will learn to present and discuss research orally as well as in writing, in groups and individually.
Methods of examination: Final Written exam **Grading:** A-F
Assessment methods: 3.5 hours written exam.
Examination aids: No calculator, no other examination aids

EDS110 Social Anthropology

Social Anthropology

Credits: 5 **Language:** English
Staff/institute: Knut G. Nustad/ Noragric
Start term: Autumn parallel
Terms: Autumn parallel
Mandatory activities: Participation in at least 2/3 of seminars and an approved presentation of group work.
Type of course: Lectures: 10 hours, seminars: 12 hours.
Contents: Lectures: Presentation of basic anthropological concepts in the study of society and culture; presentation of key exemplary anthropological analyses of society and culture; presentation of anthropological approaches to development and policy. Seminars: The students will be divided into groups to prepare presentations based on readings. Students will write an individual term paper of approx. ten pages.
Learning goals: The students will acquire basic knowledge of anthropological approaches to the study of cultural diversity and social institutions and will become familiar with basic concepts in anthropological analyses. The students will also acquire basic knowledge of how anthropology can be utilised in the study of policy and development interventions.
Methods of examination: Continous assessment **Grading:** A-F

Assessment methods: Course grade is based on the term paper. Each student chooses his/her paper topic from 2-4 topics given by the teacher, and submits a paper of 8-10 pages.

EDS115 Social Science Statistics and Methods

Social Science Statistics and Methods

Credits: 10 **Language:** English
Staff/institute: Ingunn Andersen/ Noragric
First time the course is offered: AUTUMN
Start term: Autumn parallel
Terms: Autumn parallel
Contents: The course is divided into 3 modules. 1. Introducing social science research methods; the use of qualitative and quantitative approaches, interdisciplinary, ethics, using secondary sources, reference management. 2. Quantitative analyses and basic social science statistics: understanding basic statistics, statistical inquiry, collecting and managing data, sampling, descriptive statistics, bivariate analyses and multivariate analyses, introductory use of computer programs. 3. Qualitative analyses: Data collection, analyses and interpretation of qualitative data, key qualitative methods.
Learning goals: This course will give the students an introduction to statistical understanding, statistical techniques and analysis. The course will present the students to qualitative and quantitative approaches and research methods within social science, and the relationship between the two. Identify appropriate statistical procedures to understand and perform basic analysis of quantitative data. Research ethics, critical reading and interpretation will also be in focus. This course is intended for undergraduate social science-based students without background in mathematics, statistics and research methods.
Methods of examination: Continous assessment **Grading:** A-F
Assessment methods: Portfolio of compulsory assignments (40%) Final written exam (60%).

EDS200 Environment and Development Seminar

Environment and Development Seminar

Credits: 5 **Language:** English
Staff/institute: Darley Jose Kjosavik/ Noragric
Teachers: Darley Jose Kjosavik
Start term: Autumn parallel
Terms: Autumn parallel
Prerequisites: The students must have a Bachelor,s degree.
Type of course: Students meet once a week (13 weeks = 26 hours). Students will in addition work in groups on various occasions.
Contents: The topics that will be raised in the seminar series are interdisciplinary. Among the issues that will be covered are: political economy, resource and environmental politics, philosophical and ethical issues in environment and development. The politics of environment and development in the neoliberal policy context will be a red thread running through the seminar series. It is expected that the students themselves are the main driving force in the seminars through their active participation in presentations, group work and open debates.
Learning goals: The overall goal of the Environment and Development Seminar is to raise important issues within the field of environment and development studies in a series of seminar presentations, group discussions and open debates. In addition to familiarising the students with the content of particular debates (theories, arguments and case studies), the seminars are also intended to: - Help the students develop their abilities in critical reading, reflection and analysis of scientific articles. - Facilitate the development of presentation skills of the students. - Develop the communication skills of the students by active participation in the open debate sessions. - Help the students gain cognition of developing logical argumentation in writing as well as in oral debating-both within scientific and policy-making arenas. - Develop skills in interdisciplinary-intercultural team work in research and development milieus.
Methods of examination: Continous assessment **Grading:** Pass/Fail
Assessment methods: The course grade is based on approved attendance and participation in 80% of the seminar series and group assignments.

EDS201 Communication and Current Issues in Environment and Development

Communication and Current Issues in Environment and Development

Credits: 5 **Language:** English
Staff/institute: Kjell Bjørgen Esser/ Noragric
Teachers: Several teachers at Noragric will participate.
Start term: August block
Terms: August block
Credit reduction: No credit is given in combination with EDS320.
Type of course: The course will be run full time from Monday-Friday, 9-15, during the three weeks of the August block period.
Contents: The course combines analysis of current issues in environment and development studies with improvement of written and oral communication skills. Working methods include skill-building sessions, group work and guest lectures. Focus will be placed on motivating students and developing their skills for further work in an interdisciplinary field. The course will cover sustainable development in the context of the North and South and the need for a global approach to development.
Learning goals: Students will understand and be able to explain and discuss the scope of environment and development issues in a concise written and oral language. They will become motivated for further study through presentation of current issues and experience from presentation techniques. Students will get a better understanding of what is expected of them as a master student at UMB. They will acquire skills in group work, presentation, computer work and the learning platform ClassFronter. They will become oriented 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 **Grading:** Pass/Fail
Assessment methods: The assigned grade (pass/fail) will be based on a student portfolio including: -a group report on a global issue in environment and development -an oral presentation of the report -course journal in which the students report on their attendance at skills workshops, lectures and discussions, and reflections on what they have learned.

EDS205 Development Theory and Policy

Development Theory and Policy

Credits: 15 **Language:** English
Staff/institute: Poul Wisborg/ Noragric
Teachers: Poul Wisborg, N. Shanmugaratnam, Darley Jose Kjosavik, Arild Angelsen and others (including guest lecturers)
Start term: Autumn parallel
Terms: Autumn parallel
Mandatory activities: Participation in group work. Certain individual assignments are mandatory although not the basis for setting grades.
Prerequisites: BSc/BA or the equivalent.
Type of course: The scheduled teaching time is ten hours (10 X 45 minutes) per week. This is tentatively distributed between 6 hours lectures and teacher-led discussion; 2 hours of work in groups; and 2 hours of group presentation and discussion in class. This is subject to variation, for example in the case of guest lectures or other special events. Participants are expected to spend additional time on group work and self-directed study.
Contents: The course comprises five thematic blocks of two or three weeks: 1. Introduction to Development Studies 2. Theories and policies of economic development 3. Environment, livelihoods and politics 4. Social justice and human rights in development 5. Development Studies: Review and conclusions Some cross-cutting themes are how the values and practices of development have changed over time and are contested among different groups and individuals; how wealth and poverty is produced and reproduced; how social and environmental processes are interlinked; and how different groups struggle for development and justice.
Learning goals: The course gives an introduction to Development Studies as an interdisciplinary and problem oriented study of social, political, economic and environmental dimensions of change in different societies. The course goals are: 1: To give academic understanding and overview of major approaches in Development Studies and to enable participants to critically discuss and use major theories and concepts to analyse development issues in their social and environmental contexts. 2: To develop skills in team work required in interdisciplinary research and development practice; to strengthen skills in searching,

managing and sharing information, particularly related to team work, presentations and debate; to develop writing skills for learning, reflection and communication. 3: To develop awareness of different normative approaches to development policy and practice including considering cultural diversity and international norms.
Methods of examination: Continous assessment **Grading:** A-F
Assessment methods: The examination is based on a portfolio of (i) group exercises including a group project report and (ii) various individual writing assignments including an individual term paper at the end of the semester. Further information will be given in the course plan and in class. All the assignments are mandatory. Selected assignments from the portfolio are given a grade (A-F)and the overall grade is based on the student's study progress. To get a pass in the course one must get a passing grade (E or better) in each of the graded assignments.

EDS215 Sustainable Agriculture and the Environment

Sustainable Agriculture and the Environment

Credits: 5 **Language:** English
Staff/institute: Kjell Bjørgen Esser/ Noragric
Start term: Autumn parallel
Terms: Autumn parallel Spring parallel
The course is offered: Other - The course is given twice every year.Emnet tilbys to ganger årlig, høstparallell og vårparallell.
Type of course: The course is divided into eight parts lasting one week each. Students are expected to submit responses to short assignments at the end of every week. The last week is set aside for a term paper. Students are also expected to engage actively in the virtual discussion forums.
Contents: The course deals with agricultural practices in developing countries in tropical regions. It begins with an introduction to the evolution and classification of tropical agricultural systems and continues to describe diverse water and soil management practices and policies. The environmental effects of low and high input agriculture are discussed, and the potential for sustainable agricultural intensification in marginal areas is explored within a development framework. Attention is also paid to the relevance of international conventions to agriculture and the environment in developing countries.
Learning goals: The students shall understand essential features of agricultural systems in developing countries, how different systems have evolved, and how agricultural practices influence environment and development in low-income countries.
Methods of examination: Continous assessment **Grading:** Pass/Fail
Assessment methods: Students will be evaluated on the basis of weekly short assignments and a final term paper. All assignments must be handed in prior to submitting the term paper.

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: Bachelor's degree or equivalent.
Credit reduction: STAT100
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, logistic regression, T-tests, one way-analysis of variance, two-way analysis of variance, chi-square tests.
Learning goals: Students will acquire knowledge of basic statistical models and methods that are used in applied research.
Methods of examination: Final Written exam **Grading:** A-F
Assessment methods: Final written examination.
Examination aids: Any calculator, any other examination aids

EDS225 Linking Ecological and Social Resilience

Linking Ecological and Social Resilience

Credits: 10 **Language:** English
Staff/institute: Ian Bryceson/ Noragric
First time the course is offered: AUTUMN
Start term: Autumn parallel
Terms: Autumn parallel
Type of course: The class will meet for four hours per week (two double hours). 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: - The concept of resilience - Resilience and vulnerability in ecological and social systems - 'Old' and 'new' scientific ideas and approaches - The adaptive cycle as a conceptual framework - Linked ecological-social conceptual approaches - Systems approach and social-ecological linkages - Change and uncertainty in social-ecological systems - Nurturing diversity for resilience - Local/traditional resource management systems - Combining different types of knowledge for learning - Resilience of property rights institutions - Adaptive management - Self-organization towards social and ecological sustainability - Resilience as an analytical approach - A range of international case studies - Examples of MSc research projects utilising 'resilience'
Learning goals: 'Linking Ecological and Social Resilience' will provide a basis for understanding both ecological systems and social systems, emphasising the interlinkages and interdependence between environmental and social processes of change. Emphasis is placed upon: - learning to live with change and uncertainty; - nurturing diversity for resilience; - combining different types of knowledge for learning; - creating opportunity for self-organization towards social and ecological sustainability. The course will provide students with an innovative conceptual framework, and explain how to use it as an analytical approach when investigating questions of sustainability and development with interdisciplinary perspectives. A variety of case studies from developing countries in an increasingly globalised world will be used to illustrate the theories. Several students have successfully utilised 'resilience' as a conceptual framework for their thesis in recent years. Any course participants who would like advice on this will be assisted additionally.
Methods of examination: Continous assessment **Grading:** A-F
Assessment methods: One group mid-term paper and one final written exam.

EDS240 Economics for Environment, Development and Natural Resources

Economics for Environment, Development and Natural Resources

Credits: 10 **Language:** English
Staff/institute: Fred Håkon Johnsen/ Noragric
Teachers: Pål Vedeld
Start term: Autumn parallel
Terms: Autumn parallel
Credit reduction: ECN120, ECN170, ECN210, ECN212, ECN270, ECN271-3 ECTS credits reduction for each course.
Type of course: 6 hours per week for 13 weeks.
Contents: 1. Microeconomics: Market demand. Market supply. Gross margin analysis in agriculture. The perfect market. Market imperfections. 2. Project appraisal: Social profitability. Distributional effects. The social discount rate. Net present value and other decision criteria. Shadow prices. Non-valued and non-quantified effects. Sensitivity analysis. Inflation. Alternatives to cost benefit analysis. Using Excel in project appraisal. 3. Environmental and natural resource economics: Economic approaches to sustainable development. Time and natural resource use. Economics of non-renewable resources. Economics of renewable resources. Economics of environmental pollution and pollution control. Interdisciplinarity and the environment. 4. Land, institutions and development: Land markets. Rural transfer institutions. Agrarian structure. Property rights. Land reform. Gender issues and land rights.
Learning goals: The students will be able to apply basic concepts and techniques within microeconomics, socio-economic project appraisal, resource economics and development economics in interdisciplinary analysis of problems relating to environment, agriculture, development and natural resources.
Methods of examination: Final Written exam **Grading:** A-F
Assessment methods: Final 3.5 hr written examination.

Examination aids: Any calculator, any other examination aids

EDS250 Agricultural Production Systems in Developing Countries

Agricultural Production Systems in Developing Countries

Credits: 10 **Language:** English
Staff/institute: Trygve Berg/ Noragric
Teachers: Lars Olav Eik, Jens Aune and Mai-Guri Sætre.
Start term: Spring parallel
Terms: Spring parallel
The course is offered: Even years
Prerequisites: Bachelor's degree or equivalent.
Type of course: 5 lecture hours/week for 14 weeks = 60 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. Knowledge systems and gender in agricultural development.
Learning goals: 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: Written exam.
Examination aids: No calculator, no other examination aids

EDS260 Global environmental changes

Global environmental changes

Credits: 10 **Language:** English
Staff/institute: Bishal K. Sitaula/ Noragric
First time the course is offered: AUTUMN
Start term: Autumn parallel
Terms: Autumn parallel
Mandatory activities: Submission and presentation of one group assignment.
Type of course: 30 hr lectures, 80 hr group exercises, 50 hr individual reading assignments.
Contents: Definition of terms, introduction to global change (systemic and cumulative), land degradation, other global challenges (water crises, wetlands, endangered species, drought and floods), potential impacts of climate change on food and agricultural systems, climate change impacts on biodiversity, global responses and local actions, negotiations and agreements, conventions on desertification, water conventions, conventions on biodiversity, compliance with climate change conventions, international treaties, adaptation and mitigation options, initiatives to address global change issues, case studies, early responses, climate research programs, conferences on drylands and land degradation, cooperative programs on water and climate and livelihoods.
Learning goals: Be able to describe the major elements of global change issues. Understand the natural processes relating to water, the hydrological cycle, climate change, desertification, emission of greenhouse gases and their individual as well as aggregated impacts on peoples' livelihoods. Understand national and global problems related to climate change, desertification water and biological diversity. Be familiar with relevant international conventions and agreements. Be familiar with methodological approaches, early warning and policy interventions in providing adoption and mitigation options to address global change issues.
Methods of examination: Continous assessment **Grading:** A-F
Assessment methods: Term paper 50 % and written exam 50 %.

EDS270 Development Aid and Politics

Development Aid and Politics

Credits: 5 **Language:** English
Staff/institute: Knut G. Nustad/ Noragric
First time the course is offered: AUTUMN
Start term: Autumn parallel
Terms: Autumn parallel
Contents: The course analyses the effects of foreign aid as a factor in development in poor countries, surveys the changing development doctrines, interprets roles of national and international institutions, and describes commonly used development instruments. Debates on past, current and future donor roles are covered.
Learning goals: Students will understand the theories behind foreign aid used to assist poor countries in their economic development, the effects on poverty and the changing analyses during the last fifty years.
Methods of examination: Continous assessment **Grading:** A-F
Assessment methods: One term paper and one final written exam

EDS275 Writing Seminar

Writing Seminar

Credits: 5 **Language:** English
Staff/institute: Knut G. Nustad/ Noragric
First time the course is offered: AUTUMN
Start term: Autumn parallel
Terms: Autumn parallel
Prerequisites: Eligibility for university admission
Contents: This course gives the students an opportunity to present written work that will form part of their final thesis to their fellow students and a teacher. Participants in the course will read through a student text before each seminar and prepare comments. After a short oral presentation, fellow students and the seminar teacher will offer comments and suggestions for improvements of the text.
Learning goals: The seminars aim at helping students with their written work by suggesting improvements; to develop the skill of orally presenting own material; and to develop the skill of offering constructive comments on other students' work.
Methods of examination: Continous assessment **Grading:** Pass/Fail
Assessment methods: Pass / Fail based on participation

EDS280 Land Rights: An Introduction to Theory, Applications, and Policy

Land Rights: An Introduction to Theory, Applications, and Policy

Credits: 5 **Language:** English
Staff/institute: Espen Olav Sjaastad/ Noragric
Teachers: Hans Sevatdal, Stein Holden, Håvard Steinsholdt, Darley Kjosavik
First time the course is offered: SPRING
Start term: January block
Terms: January block
Type of course: Lectures: 50 hours Group work: 50 hours Individual assignments: 50 hours
Contents: The course is divided into five components: 1. Basic concepts and theories 2. Land tenure systems 3. Property transactions 4. Property formalisation and registration 5. Policy instruments
Learning goals: After completing the course, students should: - Be familiar with fundamental property rights concepts and theories - Be able to identify distinguishing features of different tenure systems - Be able to describe different modes of property transactions and their implications - Possess knowledge of different forms of property formalisation and their motivations - Be able to analyse the effects of various instruments relevant to the politics and management of property relations
Methods of examination: Continous assessment **Grading:** A-F

Assessment methods: Student evaluation will consist of three assignments: two group assignments (30 percent each) and one individual assignment (40 percent).

EDS290 Development Classics

Development Classics

Credits: 10 **Language:** English upon request
Staff/institute: Darley Jose Kjosavik/ Noragric
First time the course is offered: SPRING
Start term: Spring parallel
Terms: Spring parallel
Mandatory activities: Participation in group presentation and attendance in two-thirds of the lectures and seminars are mandatory.
Type of course: Class hours: 4 hours of lecture, group discussions, presentations, class discussions and guidance per week for approximately 12 weeks.
Contents: The course Development Classics will include lectures, group presentations and discussions with the intention of familiarising the students with selected books that can be considered as classics that mark certain milestones in development thinking. The books selected will be heavy on the theoretical side and the students are expected to decipher and discuss the books with the guidance of the course teacher. The students are expected to take an active role in presentations and discussions throughout the course. Students will be expected to work in groups to learn to thrash out ideological and theoretical differences in relation to the practice of development. Group guidance will be given to students for presentations and individual guidance will be given for term paper writing.
Learning goals: A major learning objective of the course is to develop skills in critical reading, analysis, presentation and discussions of classical books on development thinking. The course is also expected to enable the students to understand the interconnectedness of theoretical ideas and policy practices in the arena of development through history.
Methods of examination: Continous assessment **Grading:** A-F
Assessment methods: The course grade for each student will be based on an individual, written term paper (that counts 100 % of the grade), to be submitted at the end of the semester.

EDS300 Research Methods

Research Methods

Credits: 10 **Language:** English
Staff/institute: Darley Jose Kjosavik/ Noragric
Teachers: Darley Jose Kjosavik, Ingrid Nyborg and others.
Start term: Spring parallel
Terms: Spring parallel
Prerequisites: Bachelor's degree or equivalent.
Type of course: 50 hours of lectures including some group work-two double lectures per week spread over 12 weeks.
Contents: The course will include discussions on the following topics: Ontological and epistemological underpinnings in research methods, Research questions, formulation of research proposals, the research process-from formulation of research question to final publication (with the help of case studies), research strategy and design, use of qualitative and quantitative methods, data collection, analysis and interpretation of qualitative data (participatory observation, interview, focus groups and use of language), collection and analysis of qualitative data, use of secondary data, interdisciplinary research, practical field work, introductory use of SPSS and research ethics.
Learning goals: To enable the students to grasp the theory and practice of research methods in general and to enable them to apply relevant research methods in environment and development studies.
Methods of examination: Continous assessment **Grading:** A-F
Assessment methods: The students have to write a term paper (carries 50 per cent marks) and a final written exam (carries 50 per cent marks.)

EDS310 Management of Natural Resources and the Environment

Management of Natural Resources and the Environment

Credits: 15 **Language:** English
Staff/institute: Pål Vedeld/ Noragric
Teachers: Pål Vedeld, Darley Jose Kjosavik, Thor Larsen, Gufu Oba, Ian Bryceson and others.
Start term: Spring parallel
Terms: Spring parallel
Mandatory activities: Four-day field trip in April.
Prerequisites: A Bachelor degree in relevant natural or social sciences.
Credit reduction: EDS340 reduction of 10 ects
Type of course: 8 hrs of lectures and discussion per week for approximately 10 weeks. In addition, a 4 day field trip and extensive group work.
Contents: EDS310 brings together some central topics within environment and development studies. Problems within this field are usually of an interdisciplinary character, and the study of these problems and related issues requires the combination of approaches and insights from various disciplines. Both natural and social sciences as well as policy dimensions of the issues are examined. Training in interdisciplinary analysis and synthesis is therefore an important aim in this course. The course is divided into two main parts, which are taught in blocks. Part 1: This first part (60 % of the course) consists of lectures and discussions dealing with general concepts, theories and principles related to the management of natural resources and the environment. There are two interrelated modules: The first takes up two thirds of the workload in this module. It covers conceptual and theoretical social science discussions of environmental management. The second gives a background for ecosystem management from an ecological perspective. Part 2: This part (40 % of the course) focuses on environmental planning and management using perspectives from institutional economics and political science. Students are encouraged and expected to actively participate in discussions throughout the course. In April, there is a field trip to study issues of environmental management in Norwegian municipalities. Three term papers are written in groups during the semester. The average grade of these three papers counts 50 % of the final grade and an individual written exam represents the other 50 %.
Learning goals: Acquisition of skills in interdisciplinary analysis and synthesis within the field of environment and development studies is an important learning objective in this course.
Methods of examination: Continous assessment **Grading:** A-F
Assessment methods: The course grade is set based on a total evaluation of 3 assignments (50%) and a written exam (50%)at the end of the course.

EDS315 Management of Genetic Resources: Law and Policy

Management of Genetic Resources: Law and Policy

Credits: 5 **Language:** English
Staff/institute: Åsmund Bjørnstad/ Noragric
Teachers: Fowler, Cary.
Start term: June block
Terms: June block
Mandatory activities: Compulsory participation in seminars.
Contents: First week: Origin, diffusion, exchange and ownership of genetic resources through history. Second week: National and international structures and laws for managing and governing genetic resources. Third week: How the 'system' works: Access, exchange and sharing of benefits.
Learning goals: 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: Continous assessment **Grading:** Pass/Fail
Assessment methods: The course is passed if weekly exercises are submitted and approved.

EDS320 Scientific Communication Seminar

Scientific Communication Seminar

Credits: 5 **Language:** English
Staff/institute: Kjell Bjørgen Esser/ Noragric
Teachers: Ian Bryceson.
Start term: Spring parallel
Terms: Spring parallel
Type of course: Lectures: 14 hours. Assignments: 20 hours. The students are divided into 4-5 groups consisting of max. 12 students each.
Contents: Structure of thesis and other scientific publications. Student presentation and analysis of research questions in the beginning of the semester and discussion of findings towards the end. Analysis of publications. Use and misuse of words, statistics, tables, figures, units, and references. Writing styles. Academic jargon. Plagiarism. Assignments are 1) Publication title, 2) Research objectives and methods, 3) Consistency between title and introduction, 4) The meaning of words and concepts, 5) Complex sentences, 6) Writing style, 7) Be the referee of a paper, 8) Popularising science (oral), 9) Popularising science (written), and 10) Presentation of thesis.
Learning goals: Refine scientific writing skills, improve presentations, activate critical minds, fortify confidence and eradicate plagiarism.
Methods of examination: Continous assessment **Grading:** Pass/Fail
Assessment methods: Students are required to attend at least 5 of 7 double lectures (70 %) and 6 of 8 group sessions (75 %). Students must make at least 2 presentations. All 8 assignments must be submitted in Classfronter. Passing grade is given on the basis of attendance, oral presentations and submission of approved written assignments.

EDS330 Political Ecology

Political Ecology

Credits: 5 **Language:** English
Staff/institute: Tor Benjaminsen/ Noragric
Start term: Spring parallel
Terms: Spring parallel
Mandatory activities: Students will have led at least one class presentation on the readings and written one practice essay
Type of course: There will be lectures and discussions of two hours twice a week over 10-12 weeks, which means a total of approximately 45 hours over the semester.
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 history of political ecology, discourse and narrative analysis, winners and losers of global environmental change, land and water reform, participative approaches to conservation and critiques of these, and the political ecology of sustainable development.
Learning goals: 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 extend the conceptual foundations of EDS310 (Management of Natural Resources and the Environment) and go further into the links between local, national and global levels of environmental management. The course will further train students in interdisciplinary thinking and perspectives. It will also seek to develop among students a capacity of critical analysis within the field of environment and development studies.
Methods of examination: Continous assessment **Grading:** A-F
Assessment methods: An individual take home set of essays based upon course lectures and readings. The essays will be integrative and conceptual in nature.

EDS340 Environmental Planning and Management-

Environmental Planning and Management-

Credits: 10 **Language:** English
Staff/institute: Pål Vedeld/ Noragric
Start term: Spring parallel
Terms: Spring parallel
Mandatory activities: There is a 4 day compulsory field trip.
Prerequisites: A Bachelor degree in relevant natural or social sciences.
Credit reduction: The course is part of EDS310 and there is therefore a reduction of 10 credits.
Type of course: The course work consists of 6 weeks of classroom teaching; 8 hours/week. In addition, a four day excursion and a term paper.
Contents: Governance, Policymaking, Implementation, Evaluation Overall content: The course addresses issues of the state, on governance, policymaking and environmental administrative structures and management processes. Theories and models for how to describe and understand politics and policy formulation processes are reviewed. Focus is on governance and the careful considerations of efficiency, legitimacy and environmental sound management formulated in the debate around ecological modernisation. The course takes up issues around the reflective use of policy instruments; on the use of economic, legal, administrative and pedagogic instrument and the debates over local participation as political goals and instruments. The multiple roles of people are given attention; people as environmental managers, as citizens, as resource users, as clients and as customers, and how people interpret different policy instruments. The course also takes up major causes for conflict over resource use in society and how one may reduce conflict levels in various ways. List of topics: 1. Introduction to environmental management and planning; State and politics. 2. Authority, power, structures and processes. Governance and policy formulation processes. 3. Policy instruments; categories and criteria for selection. 4. Properties of natural resources and bearings on policy instrument choice. 5. Economic, legal and pedagogic instruments in the environmental field. 6. Organisation and institutional arrangements as policy instruments. 7. Conflicts and conflict resolution in natural resource management.
Learning goals: The course provides students with a deeper understanding of environmental politics; of the analysis of structures and processes for policy formulation, implementation and evaluation. The course also gives an understanding of power use; of conflicting aims between legitimacy and efficiency and of the wise use of policy instruments in addressing conflicts over resource use. The students shall: - enhance capability to critically describe, explain and prescribe solutions to complex practical natural resource use issues - be able to address practical resource use conflicts through a hands on approach - develop an open, critical and analytical mind in addressing environment and development issues - develop a sense of 'concerned citizenship'
Methods of examination: Continous assessment **Grading:** A-F
Assessment methods: Students have a graded group term paper (counting 40%) and a written exam (counting 60%).

EDS350 Management of Dryland Resource Systems

Management of Dryland Resource Systems

Credits: 10 **Language:** English
Staff/institute: Peter Gufu Oba/ Noragric
Teachers: Oba, Gufu
First time the course is offered: AUTUMN
Start term: Autumn parallel
Terms: Autumn parallel
Mandatory activities: All lectures are compulsory.
Type of course: The 180 teaching hours will cover: Integrating science and management, Dry land environments (savannas, deserts), Ecological perspectives of grazing lands, Holistic management and ecology of grazing lands, Peoples of the dry lands (pastoralists and farmers), rangelands and livelihoods in the 21st Century, changing landscapes and triggers, biodiversity of dry lands, ecological constrains and resource use and the new range ecology, synthesis and presentations on four pastoral systems, political and ecology of desertification (case studies), social science perspectives of desertification, Changing societies and environment, Pastoralism at the periphery of the world market (comparative), Pastoral development, past and future opportunities, Introduction to Environmental history and environmental history of settler societies and research in holism of the dry lands.

Contents: EDS 350 is a new course that has been prepared for intellectual stimulation and critical syntheses of knowledge with emphasis on the Global Dry lands. The course is taught by leading researchers in the area. The course offers integrated and holistic approaches for understanding the dry land environments, integrates different scientific disciplines to improve the understanding of the ecosystems by applying scientific knowledge to management and policy. Because of the course's substantial interdisciplinary and practical nature, both natural and social science students will be interested.
Learning goals: This is an interdisciplinary course that requires students to synthesize holistic ideas related to the management of dry lands. The students will gain insights into the structure and functions of the dry lands and become familiar with theoretical and practical issues related to the management of the Global dry lands. The learning goals are critical thinking and synthesis related to how the dry lands respond to both natural and anthropogenic disturbances, as well as understanding how to use the resource responses for making management decisions and developing policies for sustainable management of these fragile ecosystems. This can be achieved by: 1. Developing skills for synthesizing information for critical thinking about the processes of dry lands that pose problems for management, 2. Understanding linkages between dry land ecosystem processes and management, 3. Critical thinking on the holistic use of the dry lands, Critical thinking on how the dry land ecosystems respond to the external and internal ecosystem drivers, 4. Critical thinking on the roles of integration of ecological and indigenous knowledge for the management of the dry lands, 5, Increased awareness of the fragility of dry land ecosystems and the risks posed by misuse, 6., Increased appreciation of the dry lands in international Global environmental conventions and 7, be familiar with the trajectories of change of the systems knowledge related to historical land use.
Methods of examination: Continous assessment **Grading:** A-F
Assessment methods: Two group presentations (counting 20% each) and one mid-term essay accounting for 20%, and final written examination accounting for 40% will be the only examination on this course.

EDS360 Conflict and Development

Conflict and Development

Credits: 10 **Language:** English
Staff/institute: Espen Olav Sjaastad/ Noragric
Teachers: N. Shanmugaratnam.
Start term: Spring parallel
Terms: Spring parallel
Mandatory activities: Participation in the workshop on conflict management and peace building is compulsory.
Type of course: A rough estimate of time allocation is as follows: Lectures: 40 hours Assignments: 30 hours Seminars/workshops: 16 hours Individual work: 26 hours
Contents: The course is divided into three modules: 1. Perspectives on development and conflict 2. Conflict and natural resources 3. Mechanisms and approaches to conflict management and resolution Modules 1 and 2 involve lectures. Module 3 is given as a compulsory workshop.
Learning goals: 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: Student 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 - identify methods previously used to manage and solve similar conflicts and to specify the strengths and weaknesses of such conflicts. 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 - demonstrating the usefulness of different types of communication tools for conflict management and resolution - 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 **Grading:** A-F
Assessment methods: One term paper (40%) and a final oral exam (60%) constitute the continuous evaluation.

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: The course will include the following topics: Historical development of concepts of gender. Gender in agriculture. Gender in resource management. Gender in development discourse. Gender and economics. Gendered methodologies and analysis.
Learning goals: 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 **Grading:** A-F
Assessment methods: The grade in the course is set on the basis of an individual term paper assignment

EDS385 Rural Development and Project Management

Rural Development and Project Management

Credits: 15 **Language:** English
Staff/institute: Kjell Bjørgen Esser/ Noragric
Teachers: Ingrid Nyborg.
Start term: August block
Terms: August block Autumn parallel
Mandatory activities: a) Submit one written group report for approval b) Present one oral group presentation
Type of course: 75 hours of lectures and a minimum of 50 hours of practice/field work. In addition, various group work sessions and presentations.
Contents: Students attend lectures by a wide range of experienced staff from universities, government agencies and nongovernmental development organisations. Several field trips will give students the opportunity to interview farmers, government agents and staff members as well as gain experience in the use of research methods. Lectures and field work will cover the framework for livelihood analysis, livelihood diversification, poverty and income distribution, farm productivity, environment and sustainability, gender and rural livelihoods, macro policies and reform agendas, field methods for collecting information needed for development projects and research, ethics in field work, management techniques for development and research projects, monitoring and evaluation of development projects, contemporary issues in development, resource and environmental management.
Learning goals: The students will be able to 1) understand and work in rural environments in developing countries, 2) develop, manage, monitor, evaluate and sustain rural development projects concerning natural resource management and sustainable agriculture, and 3) use a variety of research methods, tools and techniques relevant for analysing rural development projects. Students will acquire an overview of concepts and approaches to understanding and analysing processes of social change in rural areas in developing countries and key factors in social and economic development of local communities, within a general framework of ecological sustainability. The programme offers students the opportunity to gain a deeper insight into the strategies used by rural men and women to secure their livelihoods. The sustainable livelihood approach is used as a framework for analysis. At the same time, the course provides practical insight into how development initiatives might become more effective in combating rural poverty and food insecurity and improving people,s quality of life. The course gives students a basis for understanding relations between management and local development. Sustainable agriculture and nature resource management are analysed as a driving force in rural development. The course emphasises the acquisition of knowledge and skills needed to manage rural development projects in developing countries. Through practical training, students will acquire skills in the use of research methods, tools and techniques relevant for analysing rural development projects and conducting thesis research work.
Methods of examination: Final Written exam **Grading:** A-F
Assessment methods: The course grade is based on one written final examination.
Examination aids: No calculator, no other examination aids

EDS410 Doctoral Course in Development Studies

Doctoral Course in Development Studies

Credits: 20 **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
The course is offered: Even years
Mandatory activities: Compulsory course participation in 2/3 of the lectures.
Prerequisites: Participants should preferably hold a Master degree or equivalent.
Type of course: The course will be based on full day seminars. It will be rather intensive for 5-6 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 three main components: 1. Environment-Development Relations (5ECTS - One module) 2. Development Theory and Policy (10 ECTS - Three modules) a. Development theories in historical perspective (3) b. Globalisation, Development and democracy: Current debates and the Global-Local Nexus (3) c. Development policies and practices: Critical review and Case studies (4) 3. Research Methods (5 ECTS - One module) 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. The module in research methods offers an introduction to challenges of field research and a combination of quantitative and qualitative methods. This module is a basic block on which students will build by following elective courses in research methods according to their specific academic needs.
Learning goals: 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. The students are also trained in research methods and data analysis.
Methods of examination: Continous assessment **Grading:** Pass/Fail
Assessment methods: Term paper and oral exam

FMI310 Environmental Pollutants and Ecotoxicology

Environmental Pollutants and Ecotoxicology

Credits: 15 **Language:** English upon request
Staff/institute: Bjørn Olav Rosseland/ IPM
Teachers: Brit Salbu, Deborah Ougthon, Ole Martin Eklo and Inggard Blakar.
Start term: Spring parallel
Terms: Spring parallel
Prerequisites: KJM100.
Type of course: Lectures: 36 hours. One day of field demonstration at Lake Årungen. Dissection course with fish in laboratory for sampling of organs for analyses of pollutants.
Contents: Lectures: Sources that contribute to contamination of trace metals, radionuclides and organic pollutants in different ecosystems, concentration levels and the speciation of contaminants. Mobility, transport processes contributing to long-term

ecosystem transfer, biological uptake, accumulation and biomagnification of contaminants in living organisms. In addition, alternative countermeasures to reduce environmental impacts will be discussed. Field work: Demonstration of in situ fractioning techniques of contaminants in water, sequential extraction techniques of soil and sediments, pre-treatment and modern analytical methods. Semester assignment: Individually chosen topic.
Learning goals: Students will have knowledge about different sources contributing to environmental contamination of trace metals, radionuclides and organic pollutants and be able to assess the long-term impact for man and the environment from such contamination. 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.
Methods of examination: Continous assessment **Grading:** A-F
Assessment methods: The semester assignment counts 25%. The written final examination (3.5 hours) counts 75%.

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
Prerequisites: KJM100.
Type of course: 36 lectures: 3 hours per week for 12 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 goals: 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.

FYS220 Statistical Thermodynamics

Statistical Thermodynamics

Credits: 10 **Language:** English upon request
Staff/institute: Unni Christine Oxaal/ IMT
Start term: Autumn parallel
Terms: Autumn parallel
Prerequisites: FYS112, MATH111,
Credit reduction: TFY210, 10 Credits
Type of course: Lectures: 52 hours Exercises: 26 hours
Contents: Lectures: Four hours per week where central topics in the course are discussed. Students must acquaint themselves with the topic of the day in advance, so that there will be a real discussion. Problem classes: Two hours per week, students work individually or in pairs with exercises. The subject teacher helps if needed. Problem classes will also be used for giving mandatory tests. Basic ideas in statistical physics: The second law of thermophysics and multiplicity, entropy, effeciency, entropy in quantum physics, the canonical probability distribution, the partition function and its applications, chemical potential, free energy. Applications: Photons and phonons, the ideal quantum gas, fermions and bosons at low temperatures, chemical equilibrium, phase equilibrium, transport processes.
Learning goals: Be familiar with and understand the basic constitution of simple gases, liquids and solids when they are viewed as statistical many-particle systems. Understand and be able to explain the connection between the microscopic and macroscopic description of physical systems. Understand the microscopic basis for the second law of thermodynamics and the many and

farreaching implications of this law. Be familiar with and understand the basic principles of statistical physics as applied to systems in equilibrium. Understand how simple statistical models predict the behaviour of material systems and their environment so that the models can be confirmed experimentally. Be familiar with a number of applications. Apply the second law of thermophysics, the canonical probability distribution, the partition function and the chemical potential to; temperature radiation, chemical equilibrium, phase equilibrium, diffusion of gases and other transport phenomena. The students should also be able to formulate mathematical models and to solve and interpret these. Make quantitative calculations based on these models and interpret the results. Understand how the atomistic nature of our surroundings forms the basis for our understanding of the world around us.
Methods of examination: Continous assessment **Grading:** A-F
Assessment methods: Three compulsory exercises must be completed and approved in order to paricipate in the final exam. The final written exam is of three hours duration.

FYS381 Biological Physics

Biological Physics
Credits: 10 **Language:** English upon request
Staff/institute: Gaute Einevoll/ IMT
Teachers: Cecilia Futsæther, Unni Oxaal
Start term:
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 goals: 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 exam 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, Unni Oxaal
First time the course is offered: AUTUMN
Start term:
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 goals: 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 **Grading:** A-F
Assessment methods: The project report is evaluated 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 evaluated and counts 1/4 of the final grade. All students must attend the presentations. 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: Hans E. Plesser
Start term: Spring parallel
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 goals: 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 exam. The student will be asked questions from the curriculum by the examiner and the course teacher.

FYS387 Pattern Forming Processes

Pattern Forming Processes

Credits: 10 **Language:** English upon request
Staff/institute: Unni Christine Oxaal/ IMT
Teachers: Cecilia Futsæther.
Start term: Autumn parallel
Terms: By demand
The course is offered: Other -
Prerequisites: Basic courses in physics and mathematics.
Type of course: Discussion groups: ca. 20 hours
Contents: Discussion classes on demand, of the following topics: (i) fractals, (ii) growth models, (iii) scaling, (iv) selected systems in nature (for instance coastlines, flow routes, aggregation), (v) scaling in biological systems, (vi) modelling of branching systems such as blood veins, bronchies, plants.
Learning goals: Gain a in-depth understanding of how pattern-forming processes such as crack formation in materials, flow paths in soil, streams and rivers in a catchment area or blood veins and bronchies form complicated networks and how such systems can be modelled mathematically. Be able to orient oneself further in the scientific literature on complex systems. Be aware of and understand selected topics related to the mathematical modelling of (i) fractals, (ii) growth models, (iii) scaling, (iv) selected systems in nature (coastlines, rivers, aggregation), (v) scaling in biological systems, (vi) modelling of branching structures such as blood veins, bronchies, plants. Be able to formulate and solve simple models from pattern forming processes.

Be able to orientate oneself in and acquire knowledge from scientific literature on this subject in order to be able to describe pattern forming systems. Understand how complicated and beautiful patterns in nature can be described quantitatively through the use of physics and mathematics.
Methods of examination: Final Oral exam **Grading:** A-F
Assessment methods: Final oral exam. 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
Start term: Autumn parallel
Terms: Autumn parallel
Mandatory activities: The laboratory exercises.
Prerequisites: BIO120
Type of course: Lectures: 40 hours. Lab work: 5 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 detecting/ measuring of genetic diversity/relationship. Natural selection, mutations and novelty. Neutral theory of molecular evolution. Mammalian genome analysis/ sequencing and our past. RAPD lab experiment. Converting RAPD row data into a diversity matrix and later into an UPGMA.
Learning goals: The students should understand that all (today's and extinct) biodiversity is the outcome of Darwinian selection and other genetic mechanisms, which all have a common genetic basis. 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 Genomics

Molecular Markers for Genomics
Credits: 5 **Language:** English
Staff/institute: Manfred Joachim Heun/ INA
Teachers: Kari Vollan
Start term: January block
Terms: January block
Mandatory activities: The entire laboratory course is compulsory. This forms the basis for a laboratory report and a presentation, for which a grade will be given. The laboratory course starts on the first day of lectures.
Prerequisites: BIO120 and GEN220.
Type of course: Lectures: 30 hours. Laboratory work: 60 hours. Presentations based on selected articles and laboratory results: 10 hours.
Contents: Understand the use of DNA marker for genome analysis. DNA marker and genome analysis, construction of genome maps (linkage maps), fine-mapping via BSA (bulked segregant analysis), map-based cloning and chromosome landing, synteny and genome evolution. Physical mapping, WWW searches of genome data.
Learning goals: The enormous number of gene/allele combinations in the genomes of most living species is beyond imagination and we will learn DNA marker-based approaches for understanding genome organisation and evolution. The lab part will provide the students with hands-on experience to do DNA-based work for their MSc/ PhD work.
Methods of examination: Continous assessment **Grading:** A-F
Assessment methods: Written exam (3 hours) counts 3/5. Lab report and presentations of 1 lab result (1 hour) and presentation of one research article (1 hour) count 2/5.

GEN340 Molecular Evolution

Molecular Evolution

Credits: 10 **Language:** English
Staff/institute: Manfred Joachim Heun/ INA
Start term: Spring parallel
Terms: Spring parallel
Mandatory activities: Data labs, 1 student presentation and written reports.
Prerequisites: BIO120, GEN220 and GEN320.
Type of course: Lectures: 40 hours. Data work: 40 hours. Presentations: 5 hours.
Contents: GEN340 is as a continuation of GEN320. GEN340 will deepen the data analysis aspects and will show the power of different DNA marker systems in different species for explaining the observed sequence/ chromosome/ genome variation. After the theoretical aspects of evolution and its study via phylogenetic analyses have been reviewed, the students will have the option to apply some analysis software (hands-on). Diversity-based methods like NJ will be compared with parsimony and maximum likelihood methods. Examples that such analyses can also be used in biogeography, molecular systematics/ taxonomy, nature management, conservation genetics or ecology will be lectured, and each student will have the challenge to present one current articles her/himself possibly related to interest/ MSc topic. Finally, genome mapping with different mapping programs will be presented (again students will get hands-on experience) and possible limitations will be discussed. Comparative genomics as an alternative way to measure evolutionary changes will be presented. Future developments will be shown.
Learning goals: Mathematical approaches are needed to interpret the large amount of molecular data generated in a variety of research fields. The course takes its starting point in interpreting evolutionary processes etc. By doing some first analyses themselves, the students should be able to progress with their own MSc or PhD thesis in related research areas.
Methods of examination: Final Written exam **Grading:** A-F
Assessment methods: Written exam of 3 hours.
Examination aids: No calculator, no other examination aids

GEO222 Geology Project

Geology Project

Credits: 5 **Language:** English upon request
Staff/institute: Sylvi Haldorsen/ IPM
Teachers: Michael Heim, Jon Landvik, Rolf Sørensen.
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 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 goals: 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 have the opportunity to come into direct contact with employers and researchers in geology. The student will learn to write a report directed to the project leaders.
Methods of examination: Continous assessment **Grading:** A-F
Assessment methods: Final report.

GEO300 Hydrogeology

Hydrogeology

Credits: 10 **Language:** English upon request
Staff/institute: Jan Mulder/ IPM

Teachers: Sylvi Haldorsen, Trine Sogn, Helen French (Jordforsk), Rebecca Worsely (Geology PhD student at UiO).
Last time the course is offered: HØST
Start term: Autumn parallel
Terms: Autumn parallel
Mandatory activities: Submission of exercises.
Prerequisites: GEO220.
Type of course: Lectures: 40 hours. Exercises: 15 hours. Modelling: 12 hours.
Contents: 1. Lectures-theory. 2. Calculation exercises. 3. Assignments (assessment included in the final grade). 4. Introduction of groundwater model MODFLOW. 5. MODFLOW exercises (to be submitted and approved).
Learning goals: The student will get insight into quantitative methods for describing properties of groundwater, including the flow of water and spreading of pollution. Quantitative analysis of the transport of water and dissolved substances in porous media under saturated conditions. Use of quantitative methods, including large-scale groundwater models as prediction tools. The ability to evaluate the risk of irreversible changes in groundwater resources both in quantity and quality as a result of human encroachments is important in order to achieve good resource management. Clean groundwater is an important natural resource.
Methods of examination: Continous assessment **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. Submission: One week after the students have received the assignment. Final written examination.

GEO310 Paleoenvironment and Climate Change

Paleoenvironment and Climate Change
Credits: 10 **Language:** English upon request
Staff/institute: Jon Landvik/ IPM
Teachers: Sylvi Haldorsen.
First time the course is offered: AUTUMN
Start term: Autumn parallel
Terms: Autumn parallel
The course is offered: Even years
Mandatory activities: Information will be given at start of semester.
Prerequisites: GEO100 and GEO210.
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 goals: 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 **Grading:** A-F
Assessment methods: Information will be given at start of the semester.

GMGD210 Geodetic Measurements

Geodetic Measurements
Credits: 5 **Language:** English
Staff/institute: Ola Øvstedal/ IMT
Start term: June block
Terms: Autumn parallel June block
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 goals: 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.

GMGI290 Geographical Information-Data Capture and Analysis

Geographical Information-Data Capture and Analysis

Credits: 5 **Language:** English
Staff/institute: Owe Löfman/ IMT
Teachers: Øystein B. Dick Håvard Tveite
Start term: June block
Terms: June block
Prerequisites: EDS220 or equivalent
Credit reduction: GMGI100-3 GMGI210-2
Type of course: Lectures: 40 hours. Laboratory exercises and project work: 60 hours.
Contents: A mix of lectures, laboratory exercises, semester assignment and self-study. General: The GMGI290 course covers a general background to GIS technology and applications including different methods of data capture, manipulation of data for storage and geocoding, considering different geographic reference systems. Specific: Inclusion of data into a GIS system and conversion between different data structures in the raster-vector perspective. Data capture by GPS and image analysis of remote sensing data, satellite imagery, aerial photography. Basic spatial data analysis (buffering and overlays, how to query geographical data and basic explorative spatial statistic data anaysis (ESDA). ESDA aimes at the understanding of descriptors of spatial centrographic statistics, autocorrelation and spatial patterns (point/line and area data). Aspects of cartography and visualization of geographical data. Survey of methods for interpolation and modelling of data with deterministic and statistical methods such as proximal interpolation (Thiessen polygones), Inversed distance weighting (IDW), Variography, Kriging and Cokriging. Practical part: (Excercises at computer lab): A substantial part of the course focuse on practice in using some common GIS softwares and extensions for raster-vector data capture (digitizing maps) and analyses, image analysis and practical simple field use of GPS. A set of exercises with written manuals and tutorial, supports the exercises in the computer training laboratory. Key words: GIS basics - Data capture - Spatial analysis - Basics of spatial statistics - Spatial interpolation - Remote sensing - Image analysis - GIS practice - Cartography - Visualization.
Learning goals: After completing the course, the students should have a basic knowledge of geographical data and be able to plan and perform geographical data capture. They should also be familiar with basic techiques for manipulating and analysing geographical data in a GIS environment.
Methods of examination: Final **Grading:** Pass/Fail
Assessment methods: The evaluation will be based upon a written report and final presentation of project work at a seminar.

GMSG410 Advanced Application of GPS

Advanced Application of GPS

Credits: 15 **Language:** English upon request
Staff/institute: Ola Øvstedal/ IMT
Start term: August block
Terms: By demand
The course is offered: Other -
Mandatory activities: Student presentations.
Prerequisites: GMSG200, GMSG210, GMUJ200.
Type of course: Lectures: 80 hours.
Contents: Modelling and estimation of error sources. Multi-base station RTK. OTF ambiguity resolution.

Learning goals: Students are to master the mathematical models for precise position determination using GPS.
Methods of examination: Final Oral exam **Grading:** Pass/Fail
Assessment methods: Oral exam.

GMUJ200 Parameterbased estimation and control of quality

Parameterbased estimation and control of quality

Credits: 5 **Language:** English upon request
Staff/institute: Ola Øvstedal/ IMT
Start term: Spring parallel
Terms: Spring parallel
Mandatory activities: Compulsory exercises.
Prerequisites: MATH130, STAT100, GMLM213
Type of course: Lectures: 28 hours. Exercises: 28 hours.
Contents: Optimal estimation of parameters (e.g. coordinates). Methodes to detect outliers in observations. Quantification of integrity in the form of computed numbers for reliability. Introduction to sequential methodes and Kalman filter.
Learning goals: Master parameterestimation and propagation of errors. Have knowledgde of and ability to carry out outlier detection and reliability analyses, sequential adjustment and Kalman filter. Have knowledgde of robust estimation, conditional adjustment and parameter adjustment with conditions.
Methods of examination: Final Written exam **Grading:** A-F
Assessment methods: Final written exam of 3.5 hours.
Examination aids: Any calculator, any other examination aids

HET211 Mechanisation in animal production

Mechanisation in animal production

Credits: 5 **Language:** English upon request
Staff/institute: Knut Egil Bøe/ IHA
First time the course is offered: SPRING
Start term: June block
Terms: June block
Mandatory activities: Excursions
Prerequisites: HET210 Farm Animal Environment I TBA260 Drawing and Design of Buildings I TBM160 Architectural & Engineering Design and CAD
Type of course: Lectures: 25 hours. Excursions: 40 hours incl. group work. Planning project: 70 hours (individual assignment).
Contents: Introductory lectures (3-4 days) and excursions (total of 5-6 days), followed by planning assignments. Topics include technologies and machinery for the following functions: handling and storage of roughage, concentrates, fertilizers and bedding material, handling eggs, and milking parlours and robots. As a final course assessment, students shall submit a project in which they have planned complete machinery lines for a dairy cow, pork and a poultry operation. The project is to include a functional and technical analysis, specified choice of equipment and cost estimates.
Learning goals: Students shall become familiar with the technical and functional aspects and the capacity of all types of equipment/machinery used in modern farm animal buildings. Students shall be able to design complete machinery lines in an actual production situation, and calculate the costs of various alternatives.
Methods of examination: Final **Grading:** Pass/Fail
Assessment methods: Excursion reports (group work): 2/5 Planning assignment (individual): 3/5 The assignment is concluded with an oral discussion between student, teacher and external examiner as part of the course evaluation.

HET300 Scientific Methods in Ethology

Scientific Methods in Ethology

Credits: 10 **Language:** English upon request
Staff/institute: Bjarne Olai Braastad/ IHA

Teachers: Inger Lise Andersen, Andrew M. Janczak.
Start term: Autumn parallel
Terms: Autumn parallel
Mandatory activities: Demonstrations/exercises.
Prerequisites: HET100, HET201, STAT100.
Type of course: Week 36-42: Lectures and demonstrations/exercises (4 hours per week). Special exercises may require more time. Week 40-48: Project work (170 hours) Week 50: Presentation of project work
Contents: Lectures and demonstrations/exercises related to the knowledge aims are given in the first half of the term. A discussion of relevant research methods is part of the lessons. In the last half of the course, the projects are conducted, with a final presentation and discussion in plenary.
Learning goals: After completing the course, students should be able to describe and explain the most important ethological research methods, including their strengths and weaknesses. In addition, students should be able to work out scientifically relevant research design, as well as be able to practically conduct some of the methods. Students should be able to define ethological problems, as well as describe and explain the following aspects and methods of ethological research: naturalistic observations vs. experimental manipulations, descriptive behaviour studies, classification of behaviour, the working out of ethograms, behavioural incidents and conditions, factors that affect research design, continuous observation, spot tests of behaviour, the focal animal method, sequence analyses, various behaviour tests, observation equipment and registration equipment, computer programs for registration of behaviour, relevant data analyses, as well as the reliability and validity of behavioural data. The students are to be familiar with how behavioural data is best presented. Students should be able to apply the knowledge aims when planning research design in ethology and consider the limitations that various methods place on the interpretation of research results. Students should master the technical aspects of the selected methods they are given practical experience with. Students are to develop a critical, knowledge-based attitude towards conclusions in scientific reports on ethology. In addition, students are to evaluate the ethical sides of the research methods.
Methods of examination: Continous assessment **Grading:** A-F
Assessment methods: The two project reports are weighted each with 50% in the final evaluation. The evaluation also takes into account the extent and quality of each student's work with the projects. In a group, students may therefore receive varying grades.

HET301 The Biology of Animal Stress and Its Implications for Animal Welfare

The Biology of Animal Stress and Its Implications for Animal Welfare

Credits: 10 **Language:** English upon request
Staff/institute: Morten Bakken/ IHA
Teachers: Bjarne Braastad, Andrew Janczak.
Start term: Spring parallel
Terms: Spring parallel
Mandatory activities: Participation in discussion groups is compulsory.
Prerequisites: HET100, HET101, HET201, HFX201.
Type of course: Lectures: 12 hours Discussion groups: 14 hours
Contents: In the first part of the course, lectures are held on stress and animal welfare, fear and strategies for mastering it, as well as the neural, physiological and behavioural responses to stress. After the first weeks, the colloquium work begins. The teacher is present, but the students themselves introduce the discussion. The colloquia are, to a large extent, based on the textbook and other relevant literature.
Learning goals: After completing the course, students should have competence on stress and the mastering of stress and what relevance chronic or temporary stress has on the welfare of animals. Students should be able to describe and explain the relationship between stress and animal welfare, the brain's regulation of the stress response, the neural endocrine regulation of the stress responses, the metabolic consequences of stress, the behavioural responses to short-term and long-term stress, stress and mastering strategies, fear and stress, the effects of chronic stress, the behavioural and physiological changes that occur as a result of stress acting upon foetuses and young animals as well as the effects of genetic selection as they relate to the mastering of stress.
Methods of examination: Continous assessment **Grading:** A-F

Assessment methods: After the first part of the course there will be a partial exam which counts 2/5. The final oral exam counts 3/5.

HET302 Ethology, Special Course

Ethology, Special Course

Credits: 10 **Language:** English upon request
Staff/institute: Knut Egil Bøe/ IHA
Teachers: Inger Lise Andersen.
Start term: Spring parallel
Terms: Spring parallel
Prerequisites: HET201 Applied Ethology and Animal Welfare.
Type of course: Discussion groups: 2 hrs. once per week.
Contents: Every year, a central topic in farm animal ethology is chosen. In recent years, the topic selected has been the physical and social farm animal environment.
Learning goals: Students should be able to find material on a subtopic within farm animal ethology by searching in international literature bases and thereby selecting the relevant scientific articles. In addition, they should be able to extract the most important parts of such articles and through critical reading be aware of the weaknesses of the methodology and experiment arrangements.
Methods of examination: Continous assessment **Grading:** A-F
Assessment methods: The discussion group report counts 4/5 and the participation in discussions counts 1/5.

HET303 Farm Animal Environment II

Farm Animal Environment II

Credits: 10 **Language:** English upon request
Staff/institute: Knut Egil Bøe/ IHA
Teachers: Inger Lise Andersen and guest lecturers.
Start term: Autumn parallel
Terms: Autumn parallel
Prerequisites: HET210 Domestic Animal Environments I. HET201 Domestic Animal Ethology and Welfare.
Credit reduction: TBA240
Contents: The course lectures cover action plans for animal welfare, environmental conditions and gas, dust, light and sound, flooring and floor coverings and housing systems for cattle, swine, poultry, sheep, goats and horses. Students will also receive group work assignments covering the different sub-topics.
Learning goals: This course aims to provide students with a scientific and theoretical understanding of different animal housing systems and how these influence animal health and behaviour, but also production and labour input. Students should be familiar with key literature, and be able to conduct a literature search and write a scientific report. They should have an inquisitive approach towards new issues and be motivated to find scientific solutions.
Methods of examination: Continous assessment **Grading:** A-F
Assessment methods: Group work assignments: 3/5 Written exam: 2/5

HET401 Individual PhD course in Ethology

Individual PhD course in Ethology

Credits: 10 **Language:** English upon request
Staff/institute: Bjarne Olai Braastad/ IHA
Teachers:
Start term: Autumn parallel
Terms: Autumn parallel January block Spring parallel June block
The course is offered: Other - Course given upon demandEmnet gis etter behov
Prerequisites: Competence at master level in ethology
Type of course: The structure is to be agreed upon by the PhD student and the supervisor.

Contents: Individually planned
Learning goals: 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 an essay on a topic given by the teacher

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.
Contents: - Biological basis and possible aids for breeding work - Definition of breeding goal and discussion of registration of essential information - Economic valuation of traits in the breeding goal and calculation of economic profits of the breeding work - Optimisation of breeding plans - Optimisation of specific breeding plans for pigs, cattle, goats, poultry and perhaps fish.
Learning goals: 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 term paper.

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 will be considered to assure good study progression through the term.
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. One goes 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 a focus on programs that are specialised for breeding value calculations in practical domestic animal breeding situations, but the program matlab will be used. 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 goals: 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: Term paper.

HFA302 Management of Genetic Resources in Livestock Production

Management of Genetic Resources in Livestock Production

Credits: 10 **Language:** English
Staff/institute: Odd Vangen/ IHA
Teachers: Theo Meuwissen, John Woolliams, Erling Fimland.
Start term: Autumn parallel
Terms: Autumn parallel
Mandatory activities: Compulsory attendance at the seminars, both one's own and those of fellow students.
Prerequisites: HFA200, HFA201.
Type of course: 26 lectures and 6 student seminars in some of the topics.
Contents: Political background for management of genetic resources. Definitions and concepts + practicals. Choosing conservation strategies. Selecting breeds for conservation. How to select a few breeds? Establishing a conservation scheme: - how to do it in practice? Operation of conservation schemes. Relationships between individuals and the relationship matrix. Reducing inbreeding in selection schemes. Maximisation of genetic gain with restriction on inbreeding. Conserving genetic variation. Mating schemes. Use of genetic markers/genetic uniqueness. Student seminars after several of the topics.
Learning goals: The students will understand how to operate gene banks and conservation schemes for farm animal genetic resources. The students should gain a thorough knowledge of genetic variance, gain and inbreeding in selection schemes and how this knowledge is important for conservation schemes. The students should gain some insight into genetic markers and their use for measurements of genetic uniqueness. Political background for management of genetic resources. Choosing conservation strategies. Selecting breeds for conservation. Establishing a conservation scheme. Operation of conservation schemes. Relationships between individuals and the relationship matrix. Reducing inbreeding in selection schemes. Maximisation of genetic gain with restriction on inbreeding. For each topic there will be lectures and assignments to be done by the students.
Methods of examination: Continous assessment **Grading:** A-F
Assessment methods: Individual term paper counts 2/5 and the written exam counts 3/5. Final written exam.

HFA400 Quantitative Genetics

Quantitative Genetics

Credits: 15 **Language:** English upon request
Staff/institute: Gunnar Klemetsdal/ IHA
Start term: Autumn parallel
Terms: By demand
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 goals: To give an introduction to some research areas in quantitative genetics.
Methods of examination: Final Written exam **Grading:** Pass/Fail
Assessment methods: Written exam, 3 hours.
Examination aids: No calculator, no other examination aids

HFA401 Biometrical Methods in Animal Breeding

Biometrical Methods in Animal Breeding

Credits: 10 **Language:** English upon request
Staff/institute: / IHA
Start term: August block
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 papers 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 running vce/pest, asreml, dmu, or another variance component estimation program on a data set, and predict blup breeding values.
Learning goals: 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 **Grading:** A-F
Assessment methods: Hand-in term paper: 60 %. Written 3-hour exam: 40 %. Hand-in term paper shall show result of calculating breeding values on real data.

HFA403 Analysis of Longitudinal Data for Quantitative Genetics

Analysis of Longitudinal Data for Quantitative Genetics
Credits: 5 **Language:** English
Staff/institute: / IHA
Teachers: Daniel Gianola.
Start term: Autumn parallel
Terms: By demand
The course is offered: Other -
Mandatory activities: Attendance.
Prerequisites: Mathematical statistics at PhD (300) level. Linear algebra and matrix manipulation.
Type of course: To be given by the teacher in the course of 1-2 weeks. Approximately 10 hours of lectures/colloquia + student presentations.
Contents: Analyses of longitudinal data with mixed models. Typical applications will be lactation curves and growth curves of farm animals. Details to be given later.
Learning goals: To be able to analyse longitudinal data such as growth and lactation curves.
Methods of examination: Final Oral exam **Grading:** A-F
Assessment methods: Oral exam with external examiner.

HFE300 Animal Nutrition, Selected Topics

Animal Nutrition, Selected Topics
Credits: 5 **Language:** English upon request
Staff/institute: Anders Skrede/ IHA
Teachers: Øystein Holand.
Start term: Autumn parallel
Terms: Autumn parallel
Mandatory activities: To be approved, students are required to participate in a minimum of 3/4 of the student presentations.
Prerequisites: Knowledge of general nutrition equivalent to HFE200.
Type of course: The number of hours for structured activities is ca. 20, but this will depend on the number of students.
Contents: Presentation of main principles and important aspects in connection with the selection of a topic and the writing of the paper. The selected topics will be presented and discussed. The main contents of the course are the writing and presentation/discussion (in class) of the papers.
Learning goals: The course aims to increase students' understanding of nutrition, based on the selected topic for the term paper. After completion of the course, the students are also expected to have good insight into the basic use of scientific literature and the writing of a reference list. The student will also gain experience from an oral presentation and discussion of a paper with focus on nutrition.
Methods of examination: Final **Grading:** A-F

Assessment methods: Deadline for submission and discussion of papers is agreed upon with the students at start of the course. Evaluation of papers.

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, Harald Hetland and others.
Start term: Autumn parallel
Terms: Autumn parallel
Mandatory activities: Exercises. The exercises will deal with 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. Additionally, the course includes digestion/balance studies.
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. Chemical analyses and in vitro analyses on which energy and protein evaluation systems are based will be discussed. Demonstration experiments will be carried out on digestion/nutritive balance of monogastric animals (roosters, minks or pigs). Exercises on the calculation of energy and protein values in feedstuffs and compound feeds for monogastric animals.
Learning goals: 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, specified other examination aids

HFE305 Feed Manufacturing Technology

Feed Manufacturing Technology

Credits: 10 **Language:** English
Staff/institute: Birger Svihus/ IHA
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), lac. control etc. Feed milling administration, maintenance program and flow design.
Learning goals: 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 hours written examination.
Examination aids: Simple calculator, no other examination aids

HFE306 Advanced Feed Manufacturing Technology

Advanced Feed Manufacturing Technology

Credits: 5 **Language:** English
Staff/institute: Birger Svihus/ IHA
Start term: January block
Terms: January block
Prerequisites: The students must have taken HFE305.
Type of course: There will be 12 lecture hours in this course.
Contents: The course will mainly be based on group work carried out at the Center for Feed Technology. 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 goals: 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 **Grading:** A-F
Assessment methods: 2-3 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: Edward Perez.
Start term: Spring parallel
Terms: Autumn parallel Spring parallel
Mandatory activities: Lectures.
Prerequisites: The students must have taken HFE305.
Type of course: Ca. 4 hours per week.
Contents: The course is divided into 12 main areas or topics that are crucial for managing a feed production facility. They are: Design and construction of a feed production facility. Managing Nutrition concerns and Least cost formulation at the feed plant. Process quality issues of raw materials and their grinding. Process quality issues in dosing and mixing of raw materials. Conditioning and its nutritional consequences for the production process. Liquid ingredient application in the production process. Managing the steam system as a raw material. Managing a feed plant. Managing personnel. The Maintenance Management System of a feed plant. Quality Assurance Programs and ISO 9001 concept. Safety and health at the feed plant.
Learning goals: The goal is to gain insight into all the key processes of feed production management.
Methods of examination: Continous assessment **Grading:** A-F
Assessment methods: First term report: 7/15 Oral exam: 8/15 The evaluation will partly be based on a written, individual report prepared home over a period of at least one month. The topic will be chosen from several alternatives, summarising the topics covered in the first term. Evaluation at the end of the second term will be an oral exam. The student must have passed both parts to pass the course.

HFE308 Feed Optimalisation for Different Species

Feed Optimalisation for Different Species

Credits: 10 **Language:** English

Staff/institute: Birger Svihus/ IHA
Teachers: Trond Storebakken.
Start term: Autumn parallel
Terms: Autumn parallel
Mandatory activities: Participation in group work will be compulsory.
Prerequisites: Equivalent to one year master studies in Feed Manufacturing Technology.
Type of course: Approximately 50 hours of lecturing.
Contents: The lectures will deal with the specific needs of the following species: Cattle, sheep, goats, pigs, poultry, horses, fur animals, salmon, trout, halibut, cod, tilapia, shellfish. In addition, lectures will cover specific interactions between feed ingredients and chemical components, and processing.
Learning goals: 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: Final Oral exam **Grading:** A-F
Assessment methods: Oral examination approximately 30 minutes per student.

HFE400 Lipid Metabolism

Lipid Metabolism

Credits: 10 **Language:** English upon request
Staff/institute: Bente Ruyter/ IHA
Teachers: Hilde Sundvold, Magny Thomassen
First time the course is offered: AUTUMN
Start term: June block
Terms: By demand
The course is offered: Other - Upon demandVed 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 goals: 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

HFM200 Molecular Genetics in Animal and Aquacultural Production

Molecular Genetics in Animal and Aquacultural Production

Credits: 5 **Language:** English upon request
Staff/institute: Dag Inge Våge/ IHA
Teachers: Sigbjørn Lien,Vessela Kristensen
Start term: Spring parallel
Terms: Spring parallel
Prerequisites: BIO120.
Type of course: Week 5-19: 2 hours per week (30 hours total).
Contents: Week 5-19: Lectures related to the central themes within the teaching goals are given in the first part of the period. In addition, students work in groups on a project assignment. In the last part of the period the project assignments are presented in plenary with the teacher present. Technical contents: Gene structure and function in animals and fish. Basic genome organisation. Central methods in gene and genome analysis. Use of and potential for these technologies in animal production and aquaculture. Social and ethical questions that such use raises.
Learning goals: Students will be able to repeat and explain the basic characteristics of organisation and function of mammal and fish genes, plus be able to give an overview of and explain major gene technology methods. Students will also be familiar

with different uses of this knowledge in animal production and aquaculture. Students should be able to participate in the ethical debate on the practical use of technology and knowledge within primary production.
Methods of examination: Continous assessment **Grading:** A-F
Assessment methods: Project assignment (1/3) and written exam (2/3).

HFX150 Horse Breeding and Nutrition

Horse Breeding and Nutrition

Credits: 5 **Language:** English upon request
Staff/institute: Dag Austbø/ IHA
Teachers: Odd Vangen, Hanne Fjerdingby Olsen
Start term: August block
Terms: August block
Mandatory activities: Participation in discussion groups.
Prerequisites: Basic knowledge in biology.
Type of course: Lectures about breeding: 10 hours. Lectures about nutrition: 10 hours. Discussion group work: The rest of the time.
Contents: The course will be divided equally between breeding and nutrition. Within horse breeding, focus is on the problems related to breeding within small populations. Examples are given from existing horse breeding programmes in Norway. Within nutrition, focus will especially be on horses' nutritional requirements, nuritional content of common feeds and how this knowledge can be used to design feed rations that meet the horses' needs.
Learning goals: Breeding: Students will become familiar with the principles for development of breeding programmes for different horse breeds and achieve an understanding of the basic principles and problems associated with breeding within small populations. Nutrition: Students will learn to use literature on horse nutritional requirements to design feeding plans for horses of different breeds/types and production. They will be familiar with the nutrient content and use of the most common feeds for horses so that they can evaluate and correct existing feeding plans and give advice and guidance in practical feeding situations.
Methods of examination: Final Written exam **Grading:** A-F
Assessment methods: Written exam, 3 hours.
Examination aids: Simple 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: HFX100 or similar knowledge.
Type of course: Approximately 70 lectures, as well as term paper 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 term papers from fellow students.
Learning goals: 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 paper. 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 **Grading:** A-F
Assessment methods: The evaluation will be based on the contents of the term paper (2/3) and its presentation (1/3). The term paper may be written individually or jointly by two students.

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
Start term: August block
Terms: August block
Mandatory activities: All independent assignments
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 hypostheses.
Learning goals: 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 exam: 3 hours. The written exam has a weight of 100%. Use of course notes is allowed during exam. An examiner is used for the exam evaluation.
Examination aids: Simple calculator, specified other examination aids

HFX303 Main Course: Horses

Main Course: Horses

Credits: 15 **Language:** English upon request
Staff/institute: Dag Austbø/ IHA
Teachers: Odd Vangen, Bjarne Braastad, Knut Bøe.
Start term: Spring parallel
Terms: Spring parallel June block
Prerequisites: HFX150, HFE200, HFA200, HET100, HFA201.
Type of course: Spring parallel: Lectures (2 hours per week); discussion group work (2 hours per week) June semester: Lectures (10 hours); practical exercises/discussion groups (10 hours)
Contents: The course runs in the spring parallel and the June semester. The June semester utilises the Norwegian Horse Centre in Starum where students lodge at the centre's boarding school. The oral exam takes place at the end of the June semester. The course content is built up around the main themes of breeding, nutrition and ethology. The most common breeds and uses of horses will be discussed concerning these issues. The course includes a semester assignment.
Learning goals: Give students a basic introduction to horse breeding, nutrition and ethology. Within horse breeding it is important that students understand the special challenges of breeding work in small populations where the most important characteristics are longevity and performance within the types of competition specific to each breed. The teaching of nutrition focuses on horse nutritional requirements and the requirements set by choice of feed and ration composition for horses of different ages and training/competition. The teaching in ethology will give knowledge about horses' natural behaviour, which is the basis for understanding horses and the learning mechanisms that are utilised in taming and training of horses. The course aims to give a wide background within these subject areas, thus providing a foundation for independent study.
Methods of examination: Continous assessment **Grading:** A-F
Assessment methods: Group work 1/6, term papers 1/6 and oral examination 4/6.

HFX400 PhD Course in Nutritional Biochemistry and Physiology

PhD Course in Nutritional Biochemistry and Physiology

Credits: 15 **Language:** English upon request
Staff/institute: Anna Haug/ IHA
Teachers: Harald Volden, Magny Thomassen, Ragnar Salte, Øivind Andersen, Anders Kiessling, Knut Hove.
Start term: August block
Terms: By demand
The course is offered: By assignment
Mandatory activities: Submission of journals from the experiments. Presentation of a term paper and the submission of a short description of the subject (ca. 5 pages).
Prerequisites: Master degree in animal science or aqaculture. 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, nerve functions, skeletal and bone metabolism, lactation, respiration, temperature regulation, and metabolism changes that occur following different forms of energy and nutrient intake.
Learning goals: 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 (pass/fail) are based on the student's achievement in the oral examination at the end of the course. The examination lasts for about 1 hour.

INN320 International Entrepreneurship

International Entrepreneurship

Credits: 25 **Language:** English upon request
Staff/institute: Svein Kolstad Hansen/ IØR
Teachers: Svein Kolstad Hansen, lecturers from the Norwegian School of Entrepreneurship (Gründerskolen), foreign lecturers during the trip abroad.
First time the course is offered: SPRING
Start term: January block
Terms: January block Spring parallel
Type of course: The course is based on active participation from the students. Students will learn from lectures, seminars, group work, excursions, own activity and work as interns in start-up businesses.
Contents: 1) Innovation process and business start-up - from knowledge and research to wealth creation. 2) Write a complete business plan. 3) Practical entrepreneurship - internship in a start-up company abroad. 4) Entrepreneurship theory - course at a university abroad in cooperation with Gründerskolen. 5) Synthesis, seminar arranged in Norway after the 3-month stay abroad. For 2006 the stay abroad will be in Singapore, arranged together with the Master's degree students in Entrepreneurship at Oslo University.
Learning goals: Give the students knowledge about international challenges within entrepreneurship and innovation through participation in the Norwegian School of Entrepreneurship (Gründerskolen). Students shall be able to work out a business plan for an innovative opportunity and learn about commercialisation in an international environment.
Methods of examination: Continous assessment **Grading:** Pass/Fail
Assessment methods: There will be continuous assessment of the students, work and contribution which is concluded by an oral examination based on the work that the students have done during the course.

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: Lars Egil Haugen, Trine Sogn.
Start term: Spring parallel
Terms: Spring parallel
Prerequisites: MATH010, 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 an individually chosen topic.
Learning goals: 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 **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. The final assignment for submission is on a topic chosen by each individual participant in the course. With support from teachers, the students must find information and necessary literature themselves.

JORD221 Soil Physics, Laboratory Course

Soil Physics, Laboratory Course

Credits: 5 **Language:** English upon request
Staff/institute: Trond Børresen/ IPM
Teachers: Lars Egil Haugen.
Start term: Autumn parallel
Terms: Autumn parallel
Prerequisites: JORD101.
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 goals: 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 **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 approved.

JORD251 Soil Classification

Soil Classification

Credits: 5 **Language:** English upon request
Staff/institute: Line Tau Strand/ IPM
Start term: January block
Terms: January block
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: Soil classifications, history nationally and internationally. 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 goals: After 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, FAO/Unesco system (1975/1990) and WRB (1998),-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 **Grading:** A-F
Assessment methods: The students are assessed individually based on the report from the student-chosen assignment, which is to be submitted on the last day of the course.

JORD260 Tropical Soils, Their Properties and Management

Tropical Soils, Their Properties and Management

Credits: 5 **Language:** English
Staff/institute: Bal Ram Singh/ IPM
Teachers: Bal Ram Singh.
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 climatic change during the Quaternary, and their 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 goals: 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. The impact of past climatic changes (over the last glacial/interglacial cycle) on tropical soils as well as possible future climatic scenarios and their effect on tropical ecosystems. 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 **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: Arne Stuanes/ IPM
Teachers: Lars Bakken, Tore Krogstad, Jan Mulder, Line Tau Strand.
Start term: Spring parallel
Terms: Spring parallel
Prerequisites: MINA200.
Type of course: Lectures: 20 hours. Group work with guidance: 20 hours. Discussion of group work: 10 hours.
Contents: Metals: sources, modelling of species in soil, distribution, bioavailability, effects on plants and micro-organisms, critical loads. Decomposition of organic pollutants: microbial functions, kinetic. Long-range transported pollutants: nitrogen and acidification-comparison between Norway, Europe and China. Phosphorus in soil and on a watershed scale. Land use change: effects on downstream water quality. Each topic: 10 hours (4h lecture, 4h group work with guidance, 2h discussion of own work).
Learning goals: To understand processes in different soils which control the cycling of metals, nitrogen, sulphur, phosphorus and organic pollutants. To have an in-depth understanding of how the terrestrial environment is affected by metals, nitrogen, acid rain, phosphorus, organic pollutants and land use change. This includes an understanding of soil as habitat, effects of the mentioned compounds on different soils and resilience of the soil system.
Methods of examination: Continous assessment **Grading:** A-F
Assessment methods: Final oral examination: 50%. Semester assignment: 35%. Presentation of group work: 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: Lars Egil Haugen, Jan Mulder, Trine Sogn, Arne Stuanes. External: Dag Hessen UiO, Per Aagaard UiO.
Start term: Autumn parallel
Terms: Autumn parallel
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 goals: 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 **Grading:** A-F
Assessment methods: Final oral examination: 50%. Seminars: 20%. Semester assignment: 30%. All parts must be passed.

JORD340 Soil Fertility and Soil Management

Soil Fertility and Soil Management

Credits: 10 **Language:** English upon request
Staff/institute: Bal Ram Singh/ IPM
Teachers: T. Børresen, , T. Sogn, Tor Arvid Breland and Å. Almås.
Start term: Spring parallel
Terms: Spring parallel
Mandatory activities: Oral presentation of the semester assignment.
Prerequisites: JORD240 or JORD242, JORD241 or JORD243, JORD220.
Type of course: Lectures: 30 hours. Supervision: 10 hours. Presentation and discussion: 10 hours. Seminars: 8 hours.
Contents: Plant nutrition (sulphur, selenium and cobalt), pH's effect on the availability of nutrients, fertilization, liming and modelling of N-fertilising requirements. Soil tillage, irrigation, soil compaction, agriculture and the environment, erosion and leaching, other pollution sources
Learning goals: To understand current issues regarding plant nutrition, fertilisation, soil tillage and management in the light of newer research results while at the same time to gain an insight into the significance of these production factors for the quality of our production area and the pollution of our water systems. Insight in selected topics of plant nutrition for their current significance for crop production. To understand the effects of fertilisation and soil tillage on plant growth, sustainable production and environmental conditions. Insight into other pollution sources such as heavy metals in soil and plant systems. Students should be in a position to evaluate the effects of different cultivation practices on plant growth and the environment. He/she should be able to put them in perspective of total management of our soil and water resources. To understand sustainable use of soil resources for maintaining crop production and minimising the pollution risks of terrestrial environment.
Methods of examination: Continous assessment **Grading:** A-F
Assessment methods: Oral examination counts 60% and the semester assignment 40%. Both 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, Gerd Vegarud.
Start term: Autumn parallel
Terms: Autumn parallel
Mandatory activities: Participation in the exercises, together with a journal.
Prerequisites: Biochemistry equivalent to KJB210.
Type of course: Lectures: 35 hours. Exercises: 64 hours. Seminars: 2 hours.
Contents: The lectures start 4-6 weeks before the exercises, in order to give the necessary theoretical background. The exercise part is based on full days. The seminar is a presentation in plenary of selected topics which the students have prepared in groups. This will reflect the knowledge achieved from their exercises. One journal from the exercises is to be handed in before the examination.
Learning goals: 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.
Methods of examination: Final Written exam **Grading:** A-F
Assessment methods: Written examination, 3.5 hours.
Examination aids: No calculator, no other examination aids

KJM310 Chromatography

Chromatography

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

Staff/institute: Dag Ekeberg/ IKBM
Teachers: Elisabeth Olsen. Hanne Devle.
Start term: Spring parallel
Terms: Spring parallel
Mandatory activities: Laboratory work and course journal.
Prerequisites: General chemistry equivalent to KJM100. Organic chemistry equivalent to KJM110.
Type of course: Lectures: ca. 20 hours Laboratory work: ca. 60 hours.
Contents: Lectures given by the teacher. Presentation of assigned topics from students. Laboratory work. Evaluation followed by the writing of reports from the laboratory work.
Learning goals: 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.
Methods of examination: Final Written exam **Grading:** A-F
Assessment methods: Written examination: 3.5 hours.
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: Elisabeth Olsen.
Start term: Spring parallel
Terms: Spring parallel
Prerequisites: KJM210 or KJM211 or an equivalent introductory course in organic chemistry that includes fundamental organic structural spectroscopy.
Type of course: Ca. 16 lecture hours, divided into 4 hours per week, thereafter ca. 30 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 goals: 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 **Grading:** A-F
Assessment methods: Semester assignment: 40% of the total grade. Written examination with an external examiner: 60% of the total grade.

KJM312 Natural Product Chemistry

Natural Product Chemistry

Credits: 10 **Language:** English upon request
Staff/institute: Solveig Flock/ IKBM
Teachers: Yngve Stenstrøm.
Start term: Spring parallel
Terms: Spring parallel
The course is offered: Odd years
Prerequisites: Basic Organic Chemistry equivalent to KJM210.

Type of course: Lectures: ca. 30 hours. Assignment review: ca. 10 hours.
Contents: Lectures are given by the teacher throughout the semester. Exercises will be gone through in plenary.
Learning goals: 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, simple biosynthetic principles and basic syntheses.
Methods of examination: Final Oral exam **Grading:** A-F
Assessment methods: Oral examination, 1 hour.

KJM350 Radioactivity and Radiation Protection

Radioactivity and Radiation Protection

Credits: 10 **Language:** English upon request
Staff/institute: Brit Salbu/ IPM
Teachers: Lindis Skipperud, Ole Chr. Lind, Marit Nandrup Pettersen, Tove Loftaas, Signe Dahl.
Start term: August block
Terms: August block Autumn parallel
Prerequisites: KJM100.
Type of course: Lectures: 21 hours. Laboratory exercises: 6 exercises: 28 hours. Journal writing.
Contents: Lectures: The properties of radioactive nuclei including half life, radiation types and radio-toxicity. The biological effects of radiation and radiation protection. The use of simple measurement methods. 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.
Learning goals: 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 radioactive nuclei including half life, radiation types and radio-toxicity. 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.
Methods of examination: Continous assessment **Grading:** A-F
Assessment methods: Laboratory journals (6 journals have to be approved before the final examination) and a final written 3-hour examination. Laboratory journals count for 1/4 of the grade. Written examination (3 hours) counts for 3/4 of the grade.

KJM351 Radioecology

Radioecology

Credits: 10 **Language:** English upon request
Staff/institute: Brit Salbu/ IPM
Teachers: Deborah H. Oughton, Lindis Skipperud, Ole Chr. Lind, Tove Loftaas, Marit Nandrup Pettersen, Lene S. Heier.
Start term: Autumn parallel
Terms: Autumn parallel
Prerequisites: KJM100.
Type of course: Lectures: 18 hours. Laboratory exercises (4 exercises): 20 hours. Journal writing. Guided project assignment: time used depends on the individual.
Contents: Lectures: Radioecology and the transport and spreading of radioactive substances in various ecosystems. Radioactive sources and species (speciation). 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: An independently chosen topic.
Learning goals: 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 radioactive radiation as well as evaluations of environmental impact related to radioactive pollution. Have knowledge of radioactive sources and understand the transport of radioactive substances in various ecosystems. Understand the basis for evaluations of environmental impact and become able to conduct radio-ecological studies using tracer techniques, radiochemical separation techniques and advanced measurement methods. Have insight into evaluations of environmental impact and the use of effective countermeasures. Building qualifications that can contribute to national preparedness when in comes to the radioactive polluting of various ecosystems.
Methods of examination: Continous assessment **Grading:** A-F
Assessment methods: The laboratory journal counts 1/5. The project assignment counts 1/5. Final written examination (3.5 hours) counts 3/5.

KJM410 Organic Mass Spectrometry (MS)

Organic Mass Spectrometry (MS)
Credits: 10 **Language:** English upon request
Staff/institute: Dag Ekeberg/ IKBM
Teachers: Elisabeth Olsen.
Start term: Autumn parallel
Terms: Autumn parallel
Mandatory activities: Assignments.
Prerequisites: Good knowledge in organic chemistry and analytical chemistry.
Type of course: Ca. 60 hours of lecturing, including ca. 22 hours of discussion groups.
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 goals: Give knowledge of both the practical and theoretical background for using mass spectrometry, such as for instance GC-MS, MALDI-MS and LC-MS. The candidates should be able to use mass spectrometry for identifying organic and biological compounds. Candidates are to have knowledge of and be familiar with the various techniques used to separate the ions in a mass spectrometer, such as for instance quadrupole, sector instruments (magnets and ESA), Time of Flight (TOF), ion traps and Fourier transfer ion cyclotron resonance (FT-ICR). Spectrum interpretation is a central topic in the course and candidates will spend time interpreting structures. Students will become familiar with the theory behind the different fragmentations of various compounds in different mass spectrometers.
Methods of examination: Final Oral exam **Grading:** A-F
Assessment methods: Final oral examination.

LAD201 Computer Aided Design II -- Digital Presentation Techniques

Computer Aided Design II -- Digital Presentation Techniques
Credits: 5 **Language:** English
Staff/institute: Ramzi Hassan/ ILP
Start term: January block
Terms: January block
Mandatory activities: 80% of lectures. 80% of lab work with supervision.
Prerequisites: LAD101.
Type of course: 30% lectures. 30% lab work with supervision. 40% individual project work with supervision.

Contents: Based on lectures and practical exercises related to landscape planning design issues, the course is structured around the following four main topics: raster-based image editing with Adobe Photoshop. Vector-based CAD editing with Adobe Illustrator. Digital-based paper presentation with Adobe Indesign. Wall presentations (Video canon) with Adobe Acrobat.
Learning goals: The students will know the fundamentals of digital design and production of digital presentation. Students will know the basics of digital drawing, rendering, layout, scanning, image editing, create accurate visual presentations, and how to create visual compositions utilised in presenting design ideas and concepts. Upon completion of this course, the student will have an understanding of the following: image editing techniques, scanning and photo sketch techniques, conversion techniques vector to raster, editing vector-based drawings, vector- and raster-rendering techniques, setting up presentation layouts, incorporating images, CAD drawings and text within a presentation, presenting projects via video canon.
Methods of examination: Continous assessment **Grading:** Pass/Fail
Assessment methods: Adobe Photoshop: 40%. Adobe Illustrator: 20%. Adobe Indesign: 20%. Adobe Acrobat.

LAD301 Advanced Computer Visualisation /NOVA

Advanced Computer Visualisation /NOVA

Credits: 5 **Language:** English
Staff/institute: Ramzi Hassan/ ILP
Start term: June block
Terms: June block
Mandatory activities: 80% of lectures. 80% of lab work with supervision.
Prerequisites: LAD101, LAD201, LAA113, LAA114, LAA234.
Type of course: 25% lectures. 35% lab work with supervision. 40% individual project work with supervision.
Contents: After being introduced to a number of visualisation techniques, each student will produce an introductory assignment exploring a landscape topic and its representation. For the final project, each student can choose his or her subject case study. Lectures/seminars with plenty of in-class time for hands-on computer use. Lectures/seminars, exercises using state-of-the-art computer systems and a variety of software, equipment and approaches, including 2D and 3D modelling, animation, and digital video. Course exercises and projects will be presented in a gallery on the Internet via the NOVA web site: http://www.novaland.kvl.dk.
Learning goals: This course is an opportunity for students who master the basics of 3D modelling and digital presentation techniques to explore more thoroughly the possibilities of representing and visualising landscape architectural qualities digitally.
Methods of examination: Continous assessment **Grading:** Pass/Fail
Assessment methods: Project work.

LAFT201 Form, colour and drawing IV

Form, colour and drawing IV

Credits: 5 **Language:** English upon request
Staff/institute: Irene Rasmussen/ ILP
Teachers: Roddy Bell, Lise Farmen.
Start term: Spring parallel
Terms: Spring parallel
Mandatory activities: Compulsory excursion. 80% participation in lectures and work on exercises with deadlines based on a timetable.
Prerequisites: LAFT101, LAFT102, LAFT103.
Type of course: Lectures: 12 hours. Exercises/assignments with individual guidance: 84 hours. Exercises/assignments without guidance: 54 hours.
Contents: Introduction/lectures followed by practical assignments in topics decided upon by the course teachers.
Learning goals: Students will acquire a basic understanding of form, drawing and colour which should be their point of departure for later professional activity relating to the aesthetic development of landscape. They will practice analytical drawing, one- and two-point perspective, and perspective construction relating to free-hand drawing. Also pen drawing techniques, drawing in large format, vegetation and landscape drawing, croquis, and drawing from the life model. They will practice working with space-related problem issues of 2D and 3D, with focus on the interaction between colour, shape and space. They will

follow a course of basic design strategy which can relate to further professional practice and become familiar with concepts of transformation, abstraction, tactility, structural characteristics, morphology and the interaction of colour and form.
Methods of examination: Continous assessment **Grading:** Pass/Fail
Assessment methods: Project assignments.

LAØ333 Urban ecology

Urban ecology

Credits: 5 **Language:** English
Staff/institute: Anne-Karine Thoren/ ILP
Teachers: Andrew Bjorn, University of Washington Seattle Gary Fry, ILP Mari Sundli Tveit, ILP
First time the course is offered: AUTUMN
Start term: August block
Terms: August block June block
Mandatory activities: The field trips, the workshops and the projects
Prerequisites: Good knowledge in either ecology or landscape planning.
Type of course: Lectures: 24 hours Workshops: 20 hours Field work- field trips: 24 hours Presentations: 12 hours
Contents: The first part of the course focuses on definitions, framework and history of urban ecology as a concept. This will lead to an overview of the ecological dimension that includes urban flora and fauna, how these survive in urban environments and how they interact with people. Students will gain an understanding of urban habitat quality and the importance of patch size, diversity and connectivity in maintaining urban biodiversity. The role of urban green structures and how these contribute to urban biodiversity will be a central theme. We then move to the human dimension with an emphas is on the roles of the many services provided by urban green-blue structures including recreation, health aspects and quality of life. The third part of the course is the planning and policy dimension. Here students gain an understanding the drivers, policies, patterns, processes, and consequences of land use change stemming from human settlement . Students will be introduced to how urban ecological problems are framed, defined, and approached. There will be a mixture of lectures, workshops and field trips including small field-based projects in the first two weeks of the course. The students will work in groups with a project in the field of urban ecology during the last week. The projects will be evaluated at the end of the course.
Learning goals: Upon completion of the course, students should: be able to solve real-life problems in urban ecology with emphasis on the blue - green infrastructures of cities * understand the complexity of urban ecosystems * have an overview of the historical development of urban ecology and how it relates to different disciplines * have an understanding of the value and function of urban spaces * understand the driving forces influencing urban ecology * be able to work in an interdisciplinary setting * be able to assess the state of urban landscapes and formulate integrated solutions to complex problems
Methods of examination: Continous assessment **Grading:** Pass/Fail
Assessment methods: The students learning will supported through academic guidance during the hours assigned for group work, and through group tutorials.

LAØ370 Landscape Ecology

Landscape Ecology

Credits: 10 **Language:** English
Staff/institute: Roger K. Abrahamsen/ 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: 30% lectures and seminars 30% practical work 40% project work
Contents: Students will be introduced to landscape-ecological concepts through work with field and map data of real landscapes. They will first 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 barriers, wildlife corridors, fauna passages and the theory of metapopulations. Early in the process, the students will start working on mini projects that exemplify landscape-ecological concepts using specific examples related to the background theories and course literature.
Learning goals: - 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 **Grading:** A-F
Assessment methods: 1. Completion and presentation of mini-projects: 30%. 2. Oral defence of project: 30%. 3. Project report (various media): 40%.

LAA308 Landscape Design

Landscape Design

Credits: 20 **Language:** English upon request
Staff/institute: Ola Bettum/ ILP
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: LAA113, LAA214, 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 goals: 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 **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.

LAA315 Urban space design

Urban space design

Credits: 10 **Language:** English upon request
Staff/institute: Arne Sælen/ ILP
Teachers: Ola Bettum.
Start term: Spring parallel
Terms: Spring parallel June block
Mandatory activities: Practice, seminars and reviews.
Prerequisites: LAA113, LAA114, LAFT202, LAA215 or equivalent.
Type of course: Lectures: 25 hours. Seminars and reviews: 30 hours. Surveys and practice: 25 hours. Supervision: 10 hours.

Contents: The course consists of a theoretical part and a project part. The theoretical part will encompass methods for analysis and project development for modern, urban traffic systems. An overview over relevant examples of this kind of systems will be given. The main part of the course is a bigger, individual project assignment for a typical urban situation, for example a complex urban area, a depot area, or a traffic junction point. Inspection of relevant projects shall be arranged.
Learning goals: The students should be familiar with the most important functional requirements for projecting urban traffic areas, including construction methods for such sites. They should be able to analyse requirements related to traffic and space for such sites, and be able to develop solutions for typical situations based on analyses through concept discussion into thoroughly prepared solutions. The project should be prepared and presented in a professional manner.
Methods of examination: Continous assessment **Grading:** A-F
Assessment methods: Project assignment counting 4/5 on written work and 1/5 on presentation.

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: Spring parallel
Terms: Spring parallel
The course is offered: Other - The course is offered upon demand and if resources allow it.Emnet gis ved behov og under forutsetning av at ressurssituasjonen tlllater det.
Mandatory activities: Compulsory assignments that must be approved within the given deadlines.
Prerequisites: MATH111, MATH112, MATH140.
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 goals: Students are to learn the basic theory of partial differential equations. They are to become capable of using this theory for solving problems in biology, geomatics, physics and technology. After completing the course, the students should master the following topics: - conservation laws - the wave equation - diffusion equations - the Laplace equation - separation of variable techniques - Sturm-Liouville theory - difference methods. Students are to be able to use: - relevant methods and techniques with emphasis on practical applications - the computer programme MATLAB for solving and visualising problems that are part of the course. They should also be able to make and analyse simple mathematical models.
Methods of examination: Final Written exam **Grading:** A-F
Assessment methods: Final written exam, 3.5 hours.
Examination aids: Simple calculator, specified other examination aids

MATH310 Continuous Dynamical Systems

Continuous Dynamical Systems

Credits: 10 **Language:** English upon request
Staff/institute: John Andreas Wyller/ IMT
Start term: Spring parallel
Terms: Spring parallel
The course is offered: Other - The course is offered on demand and if the resource situation allows it.Emnet gis ved behov og under forutsetning av at ressurssituasjonen tlllater det.
Mandatory activities: Compulsory semester assignment.
Prerequisites: MATH111, MATH112, MATH130, MATH140 and MATH250.
Type of course: 4 hours lectures per week. If necessary, the students present their semester assignment and/or relevant scientific articles in a seminar.
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 goals: 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). 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 and reaction diffusion equation theory. 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 exam.

MINA301 Term Paper in Environment and Natural Ressourses

Term Paper in Environment and Natural Ressourses

Credits: 5 **Language:** English upon request
Staff/institute: Jan Mulder/ IPM
Teachers: Lars Bakken, Arne Stuanes and others.
Start term: Autumn parallel
Terms: By demand
Prerequisites: The course must be combined with one of the following courses: GEO300, JORD310, JORD315.
Type of course: Guidance, individually or in groups: max. 5 hours. Presentation in plenary: hours depend on the number of students and the chosen arrangement.
Contents: This will vary somewhat, but the approach to a scientific report follows certain standard routines and should contain as many as possible of the following points (in the approximate order): choice of topic, definition and limitation of the task, background/history, methodology, collecting data, data processing, results, interpretation, summing up/recommendations, reference list.
Learning goals: Acquire detailed knowledge of a certain subject field through literature studies (theory) possibly combined with laboratory/field studies (practical experience). Learn to formulate, conduct and present (in written and/or oral form) a scientific paper according to a well-established outline/routine. If working in groups; learn the advantages and disadvantages of teamwork at a level and in a form that is normal in research environments, in trade and industry etc.
Methods of examination: Continous assessment **Grading:** A-F
Assessment methods: Final assessment of written work (report and possibly poster), possibly combined with an oral presentation of the main contents. In addition, an oral examination may be used. This is recommended when individual grades shall be given based on group work. The assessment is connected to the related Master's course.

MVI261 Heat Engineering I

Heat Engineering I

Credits: 5 **Language:** English upon request
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: 52 hours.
Contents: Mass balances, energy balances, pumps, fans and compressors, circular processes, heat transfer, evaporation and evaporators, humid air and drying, and cooling processes.
Learning goals: 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

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

Proteins, Polysaccharides and Fat/oils; Structure and Functionality

Credits: 10 **Language:** English
Staff/institute: Gerd Elisabe Vegarud/ IKBM
Teachers: Thor Langsrud, Bjørg Egelandsdal, Elling-Olav Rukke.
Start term: Autumn parallel
Terms: Autumn parallel
Mandatory activities: The first day of lectures and start-up of 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.
Type of course: 6 hours per week (2+4). These hours are made up of lectures, group work and colloquia, student presentations and exercises. Some exercises will extend beyond normal class hours.
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 will write projects/essays and hold presentations (written/oral). Time has also been set aside for independent study and Internet searches. We recommend students to take the course in given at the Library database search. The course has invited lecturers and demonstrations from relevant industry.
Learning goals: The students are to acquire an elementary theoretical and analytical understanding of the significance that lipids and polymers of proteins and polysaccharides have for the structure and rheological properties of food, as well as their use in food and fodder products. The students should get basic knowledge of how components from vegetabilians, meat and milk can be used as ingredients in the food and feed industry.
Methods of examination: Continous assessment **Grading:** A-F
Assessment methods: Submitted written assignments, oral presentations and other group activities during the semester (40%). Written essay (14 days) handed in at the end of semester (60%).

MVI321 Fermentation Microbiology

Fermentation Microbiology

Credits: 5 **Language:** English upon request
Staff/institute: Thor Langsrud/ IKBM
Teachers: Gerd Vegarud, Terje Sørhaug. New professor will be new course coordinator.
Start term: August block
Terms: August block
Mandatory activities: Laboratory exercises and individual assignments.
Prerequisites: Knowledge of food microbiology corresponding to MVI220, biochemistry corresponding to KJB200 and food chemistry corresponding to MVI210/KJB210.
Type of course: Lectures, reviews, presentations: Lectures 40 hours. Laboratory exercises 30 hours, individual assignments: 50 hours.
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 goals: The student is to have knowledge and laboratory skills on identification, characterisation and maintenance of microbiological cultures for fermentation purposes.
Methods of examination: Continous assessment **Grading:** A-F
Assessment methods: Written exam (3.5 hours) counts 70% of the final grade. Reports of laboratory experiments count 30% of the final grade.

MVI322 Pathogenic Microorganisms

Pathogenic Microorganisms

Credits: 10 **Language:** English upon request
Staff/institute: Helge Holo/ IKBM
Start term: Autumn parallel
Terms: Autumn parallel
Prerequisites: Microbiology corresponding to BIO130. Biochemistry corresponding to KJB200.
Type of course: Lectures and discussion groups: 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 goals: 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 **Grading:** A-F
Assessment methods: Portfolio assessment and written exam. The literature paper counts 25 % and must be handed in by week 44. 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: Torfinn Torp og Andriy Kupyna.
Start term: Autumn parallel
Terms: Autumn parallel
Mandatory activities: Group work (ca. 7-9 students in each group) on a semester assignment. Exercises: 2 hours per week.
Prerequisites: BSc, unspecified.
Type of course: 6-8 hours per week for 14 weeks.
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 goals: 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: Simple calculator, no other examination aids

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
The course is offered: Even years
Mandatory activities: Lectures are compulsory.
Prerequisites: One of the following courses: MVI260/MVI261/MVI281 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 goals: 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 **Grading:** A-F
Assessment methods: 3.5 hour written examination counts 80%. Semester assignment counts 20%.

MVI381 Muscle Food Processing Technology

Muscle Food Processing Technology

Credits: 10 **Language:** English upon request
Staff/institute: Bjørg Egelandsdal/ IKBM
Teachers: Tot Bruun (Dep. of Chemistry, Biotechnology and Food Science), Tom Chr. Johannessen (The Norwegian Food Research Institute (MATFORSK)), engineers.
Start term: Autumn parallel
Terms: Autumn parallel
The course is offered: Odd years
Mandatory activities: Practical exercises and excursion.
Prerequisites: Knowledge of unprocessed food corresponding to the part about meat/fish in MVI270.
Credit reduction: NMF271, 5 credits.
Type of course: Lectures: 60-80 hours. Work in pilot installations and laboratories: 6-8 days. Student presentations of project assignments in plenary - duration depends on the number of participants. Excursion: 1 full day.
Contents: Animal welfare in connection with stunning of animals. Slaughter technology, grading and by-products of slaughter. Technology used to ensure tenderness. Process technology: Cooling, freezing, thawing and heat treatment. Minced meat technology. The use and function of selected ingredients/additives. Salting- and smoking technology. Lipid oxidation and warmed over flavour: Technology for avoiding lipid oxidation. Marinating: The process and 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 entire male pig production. Microbiology/hygiene/parasites and similar, specific for meat and fish will be included in the course, depending on the background knowledge of the participants in the course. A project may be held on this topic. Recipe optimisation methodology and (mathematical) modelling of shelf life as relevant for animal products.
Learning goals: 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 and fish 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 student will have sufficient knowledge to be able to apply their qualifications to the development of meat/fish products and be able to judge the consequences of their choices with regards to product quality. The student should be able to select raw materials, ingredients and control the process towards the desired final product quality (for selected products). The student must know methods for suggesting an improved process when faults occur in the production. The course covers topics where the well-being of animals is central to the final quality of the product. The topic also touches on environmental problems (waste materials produced by slaughter) and the spreading of diseases.
Methods of examination: Continous assessment **Grading:** A-F
Assessment methods: Project work and report: 40%. Literature evaluation: 20%. Written examination: 40%.

MVI382A Alcoholic Beverages

Alcoholic Beverages

Credits: 5 **Language:** English upon request
Staff/institute: Trude Wicklund/ IKBM
Teachers: External.
First time the course is offered: SPRING
Start term: Spring parallel
Terms: Spring parallel
Prerequisites: Knowledge of fruit and cereal raw materials equivalent to the part about vegetables in MVI270
Type of course: Ca 40 hours of lectures
Contents: Qualities of different raw materials for production of cider, beer, wine and alcohol. Emphasis will be placed on the raw material and processing methods for the quality of the finished product.
Learning goals: Students will gain advanced knowledge of production of cider, beer, wine and spiritus.
Methods of examination: Continous assessment **Grading:** A-F
Assessment methods: Project assignment.

MVI382B Cereal Technology

Cereal Technology

Credits: 5 **Language:** English upon request
Staff/institute: Trude Wicklund/ IKBM
Teachers: Anne Kjersti Uhlen, IPM.
First time the course is offered: SPRING
Start term: Spring parallel
Terms: Spring parallel
Mandatory activities: Lab exercises.
Prerequisites: Knowledge of cereal as raw material, corresponding to the part about vegetables in MVI270. Knowledge of technology corresponding to MVI281
Type of course: Lectures and exercises - ca 40 hours.
Contents: Students will gain advanced knowledge of different aspects concerning the quality and use of cereals.
Learning goals: 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. Rye and baking technology, tropical cereals - rice, maize, sorghum and millet. Niche products from cereals - Spelt - Einkorn - Buck wheat. Extrusion/breakfast cereals, pasta, biscuits and cakes, flat bread.
Methods of examination: Continous assessment **Grading:** A-F
Assessment methods: Project assignment.

MVI383A Dairy Technology

Dairy Technology

Credits: 15 **Language:** English upon request
Staff/institute: Roger K. Abrahamsen/ IKBM
Teachers: Hilde Østlie, Judith 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.
Prerequisites: Knowledge of unprocessed food equivalent to the part about milk in MVI270. Knowledge of food production processes equivalent to MVI281.
Type of course: Ca. 32 double lectures hours are planned given by the teacher at the department. The lectures will be distributed throughout the semester. 3 excursions of 4 days in total. Excursion dates are given when the course starts up. The exercises in the pilot plant and in the laboratories are done over ca. 10 days.

Contents: Milk as a raw material for dairy products. The treatment of milk in the dairy. Unfermented and fermented consumption milk products. Manufacturing of butter and butter-like products. Powdered milk. Cheese technology. Types of cheeses. Uses of whey. Brown whey cheese technology. Ice cream technology.
Learning goals: Knowledge of the composition of milk in relation to the manufacturing of various products is a central goal of the course. In addition, the students shall gain good theoretical knowledge of the various processing steps when manufacturing dairy products. Knowledge of the key manufacturing of important dairy products and knowledge of key factors for 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 are to 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 are to 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, and we have an international responsibility. The course emphasises 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: Discussion groups and practicals.
Prerequisites: Knowledge of milk as a raw material, equivalent to the milk section of MVI20. Knowledge of dairy technology equivalent to MVI383A.
Type of course: Each week, a topic is studied both through group work and in discussion groups where specific areas within the topic are covered. There will be practicals in the 3rd and 5th week of the course, each of one and a half days.
Contents: The course contains 5 major parts that are conducted as lectures and colloquia: - Technological aspects of the manufacturing of fermented milk products. - The formation of acid gel. - Yoghurt. - Mesophilic fermented milk products. - Fresh cheeses. In addition, the course contains two large practicals. Emphasis is placed on journal writing.
Learning goals: 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 **Grading:** A-F
Assessment methods: Written exam, 3.5 hours - counts 2/3. Two journals - count 1/3. 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: Hilde Marit Østlie/ IKBM
Teachers: Roger Abrahamsen.
Start term: Spring parallel
Terms: Spring parallel

Mandatory activities: Lectures, discussion groups, exercises and excursion.
Prerequisites: Knowledge of unprocessed food equivalent to the part about milk in MVI270. Knowledge of dairy technology equivalent to MVI383A.
Type of course: Lectures: 8 hours. 3 weeks discussion groups: 10 hours per week. Exercises: 24 hours. Excursion: 6 hours.
Contents: Milk requirements, cheese classification, cheese manufactuing based on ultra-filtered milk, cheese yield, equipment for cheese manufacturing, cheese ripening,low fat cheeses, special types of cheese, the sensory properties of cheese, nutritional aspects of cheese. In addition, the course contains two large exercises. Great emphasis is placed on journal writing.
Learning goals: Students are to acquire insight into and a deeper understanding of cheese manufacturing and ripening. The students are to 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 ripening of cheese and the characteristic properties of cheese. The students are to 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: Final Written exam **Grading:** A-F
Assessment methods: Written examination, 3.5 hours.
Examination aids: No calculator, no other examination aids

MVI384 Functional Foods

Functional Foods

Credits: 10 **Language:** English upon request
Staff/institute: Judith Narvhus/ IKBM
Teachers: Wicklund, Trude; Haffner, Karin; Vegarud, Gerd: Hansen, Magnor; Uhlen, Anne Kjersti.
Start term: Autumn parallel
Terms: Autumn parallel
Mandatory activities: Discussion groups.
Prerequisites: Basic knowledge of nutrition, food chemistry and microbiology at the 200 level.
Type of course: Lectures: 2 hours. Discussion groups: 4 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 goals: 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 unerstanding of how the national and international regulations affect the development within this area.
Methods of examination: Continous assessment **Grading:** A-F
Assessment methods: Presentations counts 50% and oral examination counts 50%.

MVI385 Product Development

Product Development

Credits: 10 **Language:** English upon request
Staff/institute: Elling-Olav Rukke/ IKBM
Teachers: Tomas Isaksson, Bjørg Egelandsdal, Ola Eide and others.
Start term: Autumn parallel
Terms: Autumn parallel
The course is offered: Odd years
Mandatory activities: Seminars/case studies and role plays.
Prerequisites: Bachelor's degree.
Type of course: 1. Lectures: ca. 45 hours. 2. Seminars (discussion groups): ca. 30 hours. 3. Various activities (excursion to the FoU section in a food industry): ca. 10 hours.

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 goals: Students are to acquire knowledge about a cost-effective and market-oriented innovation process from idea to launching; regarding; 1. Identifying new products. 2. Key requirements for successful product development. 3. Research design and recipe-optimising. 4. Managing and improving product development
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 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 in-depth studing 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 goals: 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 entail 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.
Methods of examination: Continous assessment **Grading:** A-F
Assessment methods: Group assignment with presentation and discussion: 40%. Written exam, 2 hours: 60%. 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.

MVI391 Diet and Health

Diet and Health

Credits: 5 **Language:** English upon request
Staff/institute: Helle Margrete Meltzer/ IKBM
Start term: January block
Terms: January block
Prerequisites: Knowledge of chemistry equivalent to MVI210 or KJB210. Knowledge of biochemistry equivalent to KJB200. Knowledge of nutrition equivalent to HFE100.
Type of course: 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.
Learning goals: Students should be updated on present-day knowledge about the relationship between diet and reduced or increased risk for health problems or disease.
Methods of examination: Continous assessment **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 40%. Written examination, counts 60%. The written examination has to be graded E or better.

MVI410 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 Elisabe Vegarud/ IKBM
Start term: Autumn parallel
Terms: Autumn parallel
The course is offered: By assignment
Prerequisites: Knowledge of Food Chemistry equivalent to BSc and MSc in Food Science.
Type of course: Together with MVI310: structured teaching: 78 hours (6 hours per week) distributed on the different teaching methods. In addition, discussion groups, self-study and literature corresponding to PhD-study.
Contents: The course consists of 3 parts: 1. polysaccharides; structure and function. 2. proteins; structure and function. 3. fats/oils; structure. Modification and application in productions. The course builds on MVI310 with additional literature.
Learning goals: Students will have knowledge of proteins, polysaccharides, fats and oils; their chemical structure and function in food engineering on a high international PhD level.
Methods of examination: Continous assessment **Grading:** Pass/Fail
Assessment methods: Written assignment (14 days) counts 60%. Presentation (oral/written) counts 40%.

MVI411 Milk Components: Quality, Health and Nutrition (NOVA Course 41B/02)

Milk Components: Quality, Health and Nutrition (NOVA Course 41B/02)
Credits: 8 **Language:** English
Staff/institute: Gerd Elisabe Vegarud/ IKBM
Teachers: NOVA and NorFa teachers from Norway, Sweden, Finland, Denmark and Iceland, plus invited guest lecturers.
Start term: Autumn parallel
Terms: Autumn parallel
The course is offered: Other - The course will be given every third year.Emnet går hvert tredje år.
Mandatory activities: Active participation in the course. Preparation of a small thesis.
Prerequisites: MSc in Dairy Science or equivalent.
Type of course: The schedule for the course is the following: 1 week preparation of literature. 1 week active participation in the course. 4 weeks preparation of the assignment at home University.
Contents: The course has the following topics: Part 1. Milk components in relation to health (NLH, 2002). Part 2. Milk proteins; Functional genomics (SLU, 2004). Part 3. Milk components; technology and processing (KVL, 2006).
Learning goals: Students are to learn about different types of milk proteins; caseins and casein micelles, whey proteins, lactoferrin, minor components, structure and functional properties. Genetic protein variants. Bioactive proteins and peptides. Types of identification and formation (in vitro/in vivo).
Methods of examination: Continous assessment **Grading:** Pass/Fail
Assessment methods: The semester assignment must be submitted within 28 days after completion of the course.

MVI470 Måling av kvalitetsegenskaper i næringsmidler med ikke-destruktive on-line målemetoder

Måling av kvalitetsegenskaper i næringsmidler med ikke-destruktive on-line målemetoder

Credits: 10 **Language:** English
Staff/institute: Elling-Olav Rukke/ IKBM
Teachers: Prof. Tomas Isaksson, Prof. Harald Martens, Prof. Paul Geladi-SLU, Prof. Frans van den Berg-KVL, Ass. prof. Knut Kvaal.
Start term: Spring parallel
Terms: Spring parallel
The course is offered: Other - The course is planned as a NOVA PhD-course. But the course will be given at UMB depending on number of interested PhD-students. The next NOVA course will be given at KVL, Denmark by Frans van den Berg.Emnet er planlagt som et NOVA PhD-kurs, men lar seg gjennomføre ved påmelding av tilstrekkelig antall PhD-studenter. Emnet går som NOVA PhD-kurs på KVL, Danmark i 2006 med Frans van den Berg er emneansvarlig.
Mandatory activities: Active participation in the structured instruction period.
Prerequisites: Approved Master's degree or equivalent documented qualifications.
Type of course: Consult the final course programme.
Contents: Detailed course programme is produced hour-by-hour during the period the course is offered. In addition, the basis is: -45 hours of individual study from provided syllabus before course start. -45 hours at UMB (lectures, demonstrations, exercises, discussions). -Minimum 230 hours for a Graduate project in the form of a peer-reviewed paper, which must be submitted within 10 weeks from the completion of the course.
Learning goals: Teaching students, instructors and industrial participants how to use chemometry and remote on-line methods to analyse multivariable data connected to characterising the quality of food products, without necessarily having extensive knowledge of mathematics and statistics.
Methods of examination: Continous assessment **Grading:** Pass/Fail
Assessment methods: Each student shall indvidually produce a written report of minimum 20 pages on a required subject after the course. The report shall be graded ‚pass/fail, by an external examiner in collaboration with the course responsible. The report should be produced as a scientific publication in accordance with the rules and guidelines for peer-reviewed papers.

MVI480 Food Process Technology

Food Process Technology

Credits: 10 **Language:** English upon request
Staff/institute: Tomas Isaksson/ IKBM
Teachers: Several members of the IKBM academic staff.
Start term: Spring parallel
Terms: Spring parallel
The course is offered: By assignment
Prerequisites: MVI280 or equivalent.
Type of course: Discussion groups 2 hours per week for 14 weeks.
Contents: The course contains basic theory at a 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 is done in discussion groups/independent study.
Learning goals: 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 Technology

Fresh Meat 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 and Technology, Animal Science or Veterinary Sciences or Biochemistry.
Type of course: Block teaching, 1 week.
Contents: Definition of fresh meat technology. Injection technology: e.g. Ca injection for improved tenderness, phosphate injection for improved water binding, injection of antioxidants. Injection from a sanitation point of view. Colour changes and oxidation. Choices of packing materials and the interaction between product and packaging. The effect of different packaging gases (in particular Oxygen) on fresh and cooked meat. Introduction of active packaging principles. Sensory aspects.
Learning goals: The students should have acquired an in-depth knowledge in chill (and to some extent frozen) storage and packing of fresh meat, as well as deterioration of selected quality parameters. The students should be able to synthesise new knowledge within the narrow area of meat science/technology chosen here. The students should be able to organise new knowledge within the framework of the course topic.
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: Terje Sørhaug, Ingolf Nes.
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 and Technology, Animal Science or 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 goals: The students should have enquired an in-depth knowledge in the different biochemical and technological aspects of producing dry-cured intact meat products. The students should be able to synthesize new knowledge within the narrow area of meat science/technology chosen here. The students should be able to organise new knowledge within the framework of the course topic.
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, Hilde Østlie.
Start term: Autumn parallel
Terms: Autumn parallel Spring parallel
The course is offered: By assignment
Prerequisites: Relevant Master's degree, preferably with focus on dairy technology. In cases of doubt, an individual evaluation of the candidate's previous knowledge must be made. In any case, candidates qulifications in dairy technology must be on the same level as the knowledge acquired by taking courses in dairy technology at the 300 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. A substantial part of the course will be production oriented, but builds on the 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 goals: Students will gain an in-depth understanding of the selected topics for the course. The knowledge level will be updated with the most recent research documentation. Within the chosen dairy technology topics, students will approach the edge of the discipline's knowledge platform.
Methods of examination: Final Written exam **Grading:** Pass/Fail
Assessment methods: A final written examination would be the normal procedure. If the course is taken completely on an individual basis, the examination form can be discussed. 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: 6 **Language:** English
Staff/institute: Siv Borghild Skeie/ IKBM
Teachers: Associate Professor Inga Ciprovica, LLU, Latvia. Professor Roger Abrahamsen, UMB. Professor Anders Andrén, SLU, Sweden. Researcher Tiiu-Maie Laht, TUT, Estonia. Associate Professor Finn Vogensen, KVL, Denmark. Professor Ylva Ardö, KVL, Denmark. Professor Tapani Alatossava, UH, Finland.
First time the course is offered: AUTUMN
Start term: August block
Terms: August block
The course is offered: Other - The course will only be given in 2006.
Prerequisites: The students participating in this course should mainly have a Master's degree in Food Science or a comparable background and the scientific content of the course will be based on this assumption.
Type of course: Self-tuition: 3 weeks, Lectures: 10 hours, Colloquia: 21 hours, Laboratory practise: 6 hours.
Contents: 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 goals: The students should during the course gain an in-depth understanding of the complexity of cheesemaking and various factors influencing the quality of the cheese. The knowledge level will be updated with the most recent research documentation. Within the chosen topics, students will approach the edge of the discipline's knowledge platform.
Methods of examination: Continous assessment **Grading:** Pass/Fail
Assessment methods: Each candidate will get 5 of the questions from the colloquia randomly picked which should be answered in a 10 pages(total) report, minimum 1 page pr. question, deadline 15. September 2006.

NATF210 Environmental monitoring

Environmental monitoring

Credits: 5 **Language:** English upon request
Staff/institute: Tron Haakon Eid/ INA
Teachers: Svein Solberg, Skogforsk

Start term: January block
Terms: January block
Mandatory activities: Two exercises
Prerequisites: STAT100
Contents: Presentations: Local and global environmental problems; objectives for monitoring; national and international environmental agreements; the role of monitoring in environmental management; ongoing monitoring programmes; design of monitoring programs; bio-indicators; thresholds and critical loads; historical reference data; field methods; sensors and measurement techniques in the field; sampling and analyses; remote sensing; telemetry; automatic stations; monitoring of forests, vegetation, soil, soil water, water, air, animals; traps for pollen, spores and insects; integrated monitoring; data handling and quality assurance; statistical properties of monitoring data; presentation techniques; data analyses. Training: Gather and present data for a given monitoring topic.
Learning goals: After the course the students shall * have an overview of the wide range of available methods for monitoring; * know the major international monitoring activities and the conventions to which they belong; * know the background for monitoring: the environmental problems; * be able to handle monitoring data and present results in a suitable way; * be able to make a sketch for a monitoring design for a given problem issue.
Methods of examination: Final Written exam **Grading:** A-F
Assessment methods: Written exam, 3 hours.
Examination aids: No calculator, no other examination aids

NATF300 Conservation Biology

Conservation Biology

Credits: 5 **Language:** English upon request
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 competency in the relevant topics. Discussions of relevant scientific papers. Progression from theory to practical examples.
Learning goals: 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: 15 **Language:** English
Staff/institute: Stein Ragnar Moe/ INA
Teachers: Jonathan E. Colman
Start term: Autumn parallel
Terms: Autumn parallel
Mandatory activities: Seminars and short reports.
Prerequisites: ECOL200 and ECOL250.
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 goals: 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 **Grading:** A-F
Assessment methods: Written exam, 3.5 hours, counts 3/5 of the grade. Semester assignment counts 2/5 of the grade.

NATF350 Community Based Natural Resuorce Management

Community Based Natural Resuorce Management

Credits: 5 **Language:** English
Staff/institute: Stein Ragnar Moe/ INA
Teachers: Thor Larsen, Fred Midtgård, Pål Vedeld
Start term: Spring parallel
Terms: Spring parallel
Mandatory activities: Class presentations
Prerequisites: ECOL250 and NATF320
Type of course: Seminars 20 hours, lectures 10 hours
Contents: During the past decade, there has been an increasing realisation that conservation and preservation of natural resources cannot be effectively achieved without incorporating local people and their needs. The first part of the course will cover the important theoretical framework for successful CBNRM. The course will explore how to integrate important ecological (e.g. island biogeography theory), social (e.g. institution building, stakeholder analysis) and economic (e.g. income generating activities, benefit sharing) tools in an integrated ecosystem management approach. The latter part of the course will focus on case studies from different parts of the world. We will study different approaches to CBNRM 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 goals: The course is designed to provide an in-depth understanding of Community-Based Natural Resource Management (CBNRM). The main goal is to explore all levels of community involvement in natural resource management, from national park outreach to complete transfer of tenure and user rights to local people.
Methods of examination: Continous assessment **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: Tor Arvid Breland/ IPM
Teachers: UMB: G. Lieblein (co-responsible); KVL: N. Sriskandarajah, J. Porter, V. Langer; SLU: L. Salomonsson; Helsinki Univ.: J. Helenius.
Start term: Spring parallel
Terms: Spring parallel
Prerequisites: Bachelor's degree or its equivalent in agriculture, 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 goals: 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 **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.

PAE302 Agroecology and Farming Systems

Agroecology and Farming Systems

Credits: 15 **Language:** English
Staff/institute: Tor Arvid Breland/ IPM
Teachers: Geir Lieblein, Nadarajah Sriskandarajah (KVL) and others.
Start term: August block
Terms: August block Autumn parallel
Mandatory activities: Field excursion.
Prerequisites: Bachelor's degree or equivalent in agriculture, economics, natural resources, human nutrition or other relevant social or natural sciences.
Type of course: Details will be given at course start.
Contents: The course consists of two interlinked parts. The real-life project work includes description, analysis and redesign of farming systems. Lectures and seminars deal with agroecology, ecological (organic) agriculture, systems thinking, learning, group dynamics, agroecosystems, sustainability, ecological principles of farm design, social dimensions, agronomic and economic issues, and from farm to global scales. Students write a group report for their clients in the farming system. They also write an individual report where they reflect on agroecological issues of the project work as well as their own learning while preparing the group report.
Learning goals: After completing the course, the students should know how to: - Describe and analyse farming systems, - link theoretical knowledge and concrete action regarding farming systems, - acquire knowledge about their own learning. Further, the students should acquire: - Knowledge of structure and functioning of conventional and ecological (organic) farming systems, - knowledge of links between disciplinary (sub-system) knowledge and systemic (holistic) approaches, - experience with methods for systems analysis, including assessment of overall system sustainability, - the ability to handle complexity and change, - the ability to link theory to real-life situations, - the ability to communicate and facilitate, - the ability to learn autonomously and life long, - experience in dealing with attitudes as part of the agroecosystem and learning community. Through real-life case studies with focus on change processes, attitudes of both students and actors in the farming system will be made explicit. The students will learn how to deal critically and constructively with attitudes and value-based choices as important system elements. Desirable attitudes of the students: open-minded, critical, spirited, determined, approachable, exploring and communicative.
Methods of examination: Continous assessment **Grading:** A-F
Assessment methods: Group report: 30%, individual report: 30%, oral examination: 30%, course contribution: 10%. Basis for the evaluation is a written group report ('client document'), a written individual paper ('learner document'), an oral presentation and discussion of their individual paper (oral examination), and the students' overall contribution to the course process.

PAE303 Agroecology and Food Systems

Agroecology and Food Systems

Credits: 15 **Language:** English
Staff/institute: Geir Lieblein/ IPM
Teachers: Tor Arvid Breland, Nadarajah Sriskandarajah (KVL) and others.
Start term: Autumn parallel
Terms: Autumn parallel
Mandatory activities: Field excursion.
Prerequisites: Bachelor's degree or its equivalent in agriculture, economics, natural resources, human nutrition or other relevant social or natural sciences. Builds on PAE302 or similar.
Type of course: Details will be given at course start.

Contents: The course consists of two interlinked parts. In the real-life project work, redesign of food systems are dealt with. Students write a group report for their clients in the food system and an individual report where they reflect on their own learning while preparing the group report. In lectures and seminars the following topics are dealt with: Extension and rural development, global and local food systems, food distribution, consumer issues on food, systems ecology, food security, nutrient flows and recycling, intercultural learning, interview techniques, visionary thinking, dialogue, force field analysis, creative problem solving, facilitation.
Learning goals: After completing the course, the students should know how to: - Describe and analyse food systems, - link theoretical knowledge and concrete action regarding food systems, - acquire knowledge about their own learning. Further, the students should acquire: - knowledge of structure and functioning of conventional and ecological or local food systems, - knowledge of links between disciplinary (sub-system) knowledge and systemic (holistic) approaches, - experience with methods for systems analysis, including assessment of overall system sustainability, - the ability to handle complexity and change, - the ability to link theory to real-life situations, - the ability to communicate and facilitate, - the ability to learn autonomously and life long, - experience in dealing with attitudes as part of the agroecosystem and learning community. Through real-life case studies with focus on change processes, attitudes of both students and actors in the food system will be made explicit. The students will learn how to deal critically and constructively with attitudes and value-based choices as important system elements. Desirable attitudes of the students: open-minded, critical, spirited, determined, approachable, exploring and communicative.
Methods of examination: Continous assessment **Grading:** A-F
Assessment methods: Group report: 30%, Individual report: 30%, oral examination: 30%, course contribution: 10%. Basis for the assessment is a written group report (‚client document‚), a written individual paper (‚learner document‚), an oral presentation and discussion of their individual paper (oral examination), and the students' overall contribution to the course process.

PGN350 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: Helge Skinnes, Morten Lillemo.
Start term: August block
Terms: August block Autumn parallel
The course is offered: Even years
Mandatory activities: All practicals.
Prerequisites: PGN210 or similar level, PLV220.
Type of course: The course is divided in two parts: one focusing on theory, given in the June block and one week in the August block. The course will be coordinated with other field courses.
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 practical exercises and review articles on different systems to draw the line from Mendel to molecular genetics and genetic modification.
Learning goals: Student shall understand the evolutionary genetics of host-pathogen interactions and how it may be affected/manipulated through breeding of resistant cultivars. Sustainable use of resistance genes in plants as part of IPM strategies. Inoculation and disease-assessment techniques, analysis of resistance in plant populations. To understand that (1) pathogens can rarely be exterminated, (2) that low levels may be acceptable and (3) plant protection strategies based on resistance that expose the pathogen to extreme selection pressures are not sustainable.
Methods of examination: Continous assessment **Grading:** A-F
Assessment methods: Written examination (50%) and assessment of the presentations (50%).

PGN410 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: August block 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 in March-June on a 500 pages long compendium of selected papers.
Contents: Compendium with original literature. Topic given before lecture. Participation in the course week.
Learning goals: 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 **Grading:** Pass/Fail
Assessment methods: Intensive course, 1 week in Finland. Abstract and 45 minute lecture on an assigned topic within the course agenda. Active participation in discussions.

PHA200 Plant Propagation - Traditional and Biotechnological Methods

Plant Propagation - Traditional and Biotechnological Methods

Credits: 10 **Language:** English upon request
Staff/institute: Trine Hvoslef-Eide/ IPM
Teachers: Tore Bjor, Anne Kjersti Uhlen, and others.
Start term: Spring parallel
Terms: Spring parallel
Prerequisites: Fundamental knowledge about plant physiology and anatomy is an advantage.
Credit reduction: PHA201 is reduced by 5 credits.
Type of course: Variable: Lectures: 2-4 lectures per week. Exercises: 2-3 hours per week.
Contents: The course is designed with a theoretical part (lectures) and a practical part (exercises) on the following topics: Genetic, physiological and environmental factors as a basis for plant propagation. Seed propagation (generative propagation): seed anatomy and development, ripening, cleaning and storage. Seed dormancy, delayed germination, germination. Vegetative propagation: Tuber propagation, propagation through cuttings, grafting. Micro-propagation, stock solutions, and nutrient media, selection of plant material, disinfections, axilary and adventitious shoots, somatic embryogenesis, bioreactors for mass propagation of plants, root formation and transfer to soil. The topic project is carried out in groups and the results are presented to the class.
Learning goals: After completing the course, the student is to be familiar with traditional and biotechnological propagation of plants and able to explain important conditions for successful propagation of plants in different plant groups. Through writing journals and working with topic projects, the students gain knowledge and a good understanding of plant propagation. The students acquire skills in practical propagation through their own work, the presentations of the topic projects and through working in small groups. This way of working gives a good foundation for good, professional discussions that also include attitudes.
Methods of examination: Continous assessment **Grading:** A-F
Assessment methods: Assessment of the reports from exercises (50%) and the thematic essay (50%).

PHA201 Plant Biotechnology in Depth

Plant Biotechnology in Depth

Credits: 10 **Language:** English upon request
Staff/institute: Trine Hvoslef-Eide/ IPM
Teachers: Odd Arne Rognli, Magnor Hansen, Tone Melby and others.
Start term: Spring parallel
Terms: Spring parallel

Credit reduction: PHA200 and PHA202 are reduced by 5 and 5 credits respectively. If a student wants in-depth knowledge of propagation by traditional and biotechnology as well as plant biotechnology for breeding purposes, he/she should take PHA200 plus PHA202 without reduction in credits.
Type of course: Lectures: 2-4 hours per week. Exercises: 2-3 hours per week.
Contents: The course consists of a theoretical part (lectures) and a practical part (exercises) with the following topics: nutrient media, sterile technique, anther/microspore cultures, somatic embryogenesis, suspension and callous cultures, bioreactors for mass propagation of plants, gene expression, transformation methods and root formation and transfer into soil. Risk evaluations. The laws and regulations of genetic engineering in Norway and internationally. Thematic project. The course is a combination of the biotechnology part of PHA200 and the whole of PHA202.
Learning goals: After completing the course, the students should be able to participate in debates on GMOs. They should be familiar with the techniques of cell and tissue culture that are used for mass propagation and in plant breeding. Through the writing of reports and work on a thematic project, the students acquire knowledge of and a good understanding of plant biotechnology. The students gain skills through their own effort in the laboratory and the presentations of the thematic projects, as well as through working in groups. This is a good basis for academic discussions that also deal with attitudes. Ethics and risk evaluation are a natural part of the course, since genetic engineering is covered.
Methods of examination: Continous assessment **Grading:** A-F
Assessment methods: Written examination, 3 hours: 1/3. Journal: 1/3, and thematic essay: 1/3.

PHA202 Plant Biotechnology

Plant Biotechnology

Credits: 5 **Language:** English upon request
Staff/institute: Trine Hvoslef-Eide/ IPM
Teachers: Odd Arne Rognli, Magnor Hansen, Tone Melby and others.
Start term: Spring parallel
Terms: Spring parallel
Mandatory activities: Group work, laboratory exercises.
Credit reduction: PHA201 is reduced by 5 credits.
Type of course: Lectures: 2 hours per week. Exercises: 2-4 hours per week.
Contents: The course has a theoretical part (lectures) and a practical part (exercises) on the following topics: Nutrient media, sterile technique, anther/microspore cultures, transformation methods, gene expression. Risk evaluations. Ethics. Social benefits. The law of genetic engineering and regulations in Norway and internationally. Laboratory exercises with a report.
Learning goals: After completing the course, students are to be familiar with the working methods in and central problems of cell and tissue culture techniques used in mass propagation and plant breeding. Through journal writing and academic discussion in class, the students gain knowledge and a good understanding of plant biotechnology. Students gain skills through their own efforts in the laboratory. This way of working gives a solid foundation for good, academic discussion that also deals with attitudes. Ethics is a natural part of the course, since genetic engineering is covered by the course.
Methods of examination: Continous assessment **Grading:** A-F
Assessment methods: Written examination, 3 hours: 50%. Laboratory report: 50%.

PHA223 Greenhouse and Nursery Crops I

Greenhouse and Nursery Crops I

Credits: 15 **Language:** English upon request
Staff/institute: Hans Ragnar Gislerød/ IPM
Teachers: Sissel Torre, Ingjerd Solfjeld, Ørjan Omdal, Liv Knudzon.
Start term: January block
Terms: January block Spring parallel
The course is offered: Odd years
Mandatory activities: Excursions.
Prerequisites: PJH200 or equivalent.
Type of course: Lectures: 50 hours. Assignments/exercises: 20 hours. 4 excursions.

Contents: Climate, growth media, nutrient supply and applied plant physiology. Framework conditions and development tendencies. Propagation and production of young plants. Plant quality and production systems. Production of herbs, tomatoes, cucumbers, cut flowers, pot plants, plants for planting outside, deciduous and evergreen bushes, fruit trees, berry plants, deciduous trees, climbers, roses and herbaceous perennial plants.
Learning goals: Gain knowledge of greenhouse production, the running of nurseries and the most commonly used production methods for plants for indoor environments, landscapes and urban greeneries.
Methods of examination: Continous assessment **Grading:** A-F
Assessment methods: Oral exam, duration: ca. 45 minutes. Assignments count 2/5 and oral exam counts 3/5. The assignments are given throughout the course.

PHA224 Greenhouse and Nursery Crops II

Greenhouse and Nursery Crops II
Credits: 20 **Language:** English upon request
Staff/institute: Hans Ragnar Gislerød/ IPM
Teachers: Sissel Torre, Liv Knudzon, Ingjerd Solfjeld, Ørjan Omdal, Idun Bratberg.
Start term: January block
Terms: January block Spring parallel June block
The course is offered: Odd years
Mandatory activities: Excursions.
Prerequisites: PJH200 or equivalent.
Credit reduction: PHA223, 15 credits.
Type of course: Lectures: 50 hours. Assignments/exercises: 50 hours. 4 excursions.
Contents: Climate, growth media, nutrient supply and applied plant physiology. Framework conditions and development tendencies. Propagation and the production of young plants. Plant quality and production systems. Production of herbs, tomatoes, cucumbers, cut flowers, pot plants, plants for setting outside, deciduous and evergreen bushes, fruit trees, berry plants, deciduous trees, climbers, roses and herbaceous perennial plants. Replaces PHA220, PHA221, PHA222 and PHA231.
Learning goals: The students are to acquire knowledge of greenhouse production, the running of nurseries and the most commonly used production methods for plants used for indoor environments, landscapes and urban greeneries.
Methods of examination: Continous assessment **Grading:** A-F
Assessment methods: Oral exam, duration: ca. 45 minutes. Assignments count 11/20 and oral exam counts 9/20.

PHA225 Greenhouses and Nursery Crops III

Greenhouses and Nursery Crops III
Credits: 5 **Language:** English upon request
Staff/institute: Hans Ragnar Gislerød/ IPM
Teachers: Sissel Torre and others.
First time the course is offered: SPRING
Start term: January block
Terms: January block
The course is offered: Odd years
Mandatory activities: Excursion.
Credit reduction: 5 credit reduction versus PHA223 and PHA224.
Type of course: Lectures: 40 hours.
Contents: Cultivating systems, the climate used to optimalise growth and quality in some major cultures.
Learning goals: To gain an understanding of the production conditions in a greenhouse valued at NOK 1500 million. Gain an overview of which cultivating systems are used and a few major cultures.
Methods of examination: Continous assessment **Grading:** A-F
Assessment methods: 40 minute oral exam, 3/4. Exercises 1/4.

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: Hans Ragnar Gislerød and others.
Start term: Autumn parallel
Terms: Autumn parallel
Prerequisites: BOT200, PHA223 or Bachelor's degree in Plant Science.
Type of course: Lectures: 52 hours, 4 hours per week for 13 weeks. Exercises: 26 hours, 2 hours per week for 13 weeks. Computer room. Excursion: 1 day, 8 hours.
Contents: The following central topics are covered thoroughly: 1. Fertilisation planning. 2. Growth, development physiology and growth regulation. 3. Post-harvest physiology and the use of plants in indoor environments. The course is 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 goals: 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. The post-harvest physiology of flowers and the use of plants in an indoor environment. The 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 **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 minutes per candidate.

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: Hans Ragnar Gislerød and others.
Start term: Autumn parallel
Terms: Autumn parallel
Prerequisites: BOT200, PHA223 or Bachelor's degree in Plant Science.
Credit reduction: PHA320, 10 credits.
Type of course: Lectures: 52 hours, 4 hours per week for 13 weeks. Exercises: 26 hours, 2 hours per week for 13 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 thoroughly: 1. Fertilisation planning. 2. Growth, development physiology and growth regulation. 3. Duration physiology and the use of plants in indoor environments. 4. Semester assignment. The course has a distinct environmental profile.
Learning goals: After completing the course, the student is going to have a deep understanding of applied plant physiology and fertilisation planning as a basis for an effective and environmentally friendly production of flower plants of high quality 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 **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 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: Roar Moe.
Start term: Spring parallel
Terms: Spring parallel
The course is offered: By assignment
Prerequisites: BOT200, PHA223 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 already running projects.
Learning goals: The student is to have theoretical depth on certain topics in applied plant physiology related to floriculture.
Methods of examination: Final **Grading:** A-F
Assessment methods: Semester assignment.

PHA340 In situ RNA hybridisation techniques

In situ RNA hybridisation techniques

Credits: 5 **Language:** English upon request
Staff/institute: Trine Hvoslef-Eide/ IPM
Teachers: Trygve Krekling.
Start term: January block
Terms: January block
Mandatory activities: Exercises.
Type of course: There will normally be activities from 9am-3pm 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 plant material, in agreement with the teacher, so that preparations can be made. The students have to hand in a lab description that has to be approved.
Learning goals: 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 **Grading:** Pass/Fail
Assessment methods: Submitted laboratory report.

PHA341 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
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 goals: 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 **Grading:** Pass/Fail
Assessment methods: 2 reports, each counting 50%. Presentation.

PHI400 Philosophy of Science and Research Ethics

Philosophy of Science and Research Ethics

Credits: 10 **Language:** English
Staff/institute: Terje Kvilhaug/ IØR
Teachers: Terje Kvilhaug is course responsible in 2006, whereas Frode Kjosavik gives about half of the lectures.
Start term: Autumn parallel
Terms: Autumn parallel
Mandatory activities: The students must attend at least 70% of lectures and seminars.
Type of course: 4 hours weekly: ca. 2/3 lectures, 1/3 seminar.
Contents: Two parts: Part I: Philosophy of science This part deals with both natural and social sciences. Different views will be discussed - theories, methodology, modelling and theory formation, scientific progress, realism and relativism, what is characteristic of various sciences and what is the relation between them (including reductionism and interdisciplinary potential). Part II: Research Ethics and the Social Responsibility of Science This part treats general ethical theories and more specifically norms and values that govern and legitimate scientific research. The relation between society, science and technology on the one hand, and between science, politics and expertise on the other, will be discussed. The course will also go into issues concerning bioethics and legislation as well as environmental ethics and politics.
Learning goals: The course takes science in practice as its point of departure, i.e. science as it is carried out and its diverse ways within the social and cultural sphere. The course looks at what is specific about scientific practice - its rationality and methods in different fields, how it is influenced from the surrounding society and how it in its turn has consequences for the society. The objective of the course is to stimulate students to reflect critically on their own field of research and their own research projects, in particular on methodological, social, political and ethical aspects of their own scientific activity. The objective is to increase critical awareness and sense of responsibility in the student, and to make her or him more informed on questions pertaining to philosophical and ethical questions concerning science and research.
Methods of examination: Final **Grading:** Pass/Fail
Assessment methods: Semester assignment.

PLV420 Diagnostics in Plant Pathology

Diagnostics in Plant Pathology

Credits: 5 **Language:** English
Staff/institute: Anne Marte Tronsmo/ IPM
Teachers: Dr. Alison Lees, Scottish Crop Research Institute, UK. Dr. Roger Cook, former at Central Science Laboratory, UK. Professor Jonathan Yuen, SLU. Dr. Paula Persson, SLU. Professor David Collinge, KVL. Dr. Mette Lübeck, KVL. Professor Jari Valkonen, HU. Reseachers at The Norwegian Institute for Agricultural and Environmental Research.
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: 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: The course will give an overview of: ·Current practice regarding diagnosis of plant pathogens · The theory behind common techniques used for diagnosis of plant pathogens. This will include traditional methods like interpretation of visual symptoms and microscopic techniques as well as nucleic acid based and serological techniques. ·New developments in diagnostics which are likely to make an impact in the future.
Learning goals: To know how to make an accurate identification of plant diseases, which is essential for virtually all aspects of plant pathology, from fundamental research on the biology of pathogens and disease epidemiology to the control of the diseases they cause. The students should gain an overview of current practice regarding diagnosis of plant pathogens; Be able to explain the theory behind common techniques used for diagnosis of plant pathogens, including traditional methods like interpretation of visual symptoms and microscopic techniques as well as nucleic acid based and serological techniques; Be familiar with new developments in diagnostics which are likely to make an impact in the future.
Methods of examination: Continous assessment **Grading:** Pass/Fail

PØL300 Agroecosystems

Agroecosystems

Credits: 10 **Language:** English
Staff/institute: Marina Azzaroli Bleken/ IPM
Teachers: Several UMB teachers.
Start term: Spring parallel
Terms: Spring parallel
Mandatory activities: First lesson. Student seminars. Discussion of the exercises assigned by the teacher.
Prerequisites: Bachelor's degree in Agronomy, Agriculture, Plant Science or corresponding, or PAE302 + PAE303.
Type of course: 5 hours/week.
Contents: Agroecology in a historical perspective, biodiversity, elements of epidemiology, food cycle, local and global food supply, analysis of agroecosystems on regional and farm level. The students will have to reflect upon advantages and limitations of both conventional and organic agriculture.
Learning goals: The students will acquire basic understanding of the diversity and complexity of the factors that control an agroecosystem,s sustainability.
Methods of examination: Continous assessment **Grading:** A-F
Assessment methods: Active participation in class: 30%, oral exam: 70%.

PØL301 Term Paper in Agroecology

Term Paper in Agroecology

Credits: 10 **Language:** English upon request
Staff/institute: Marina Azzaroli Bleken/ IPM
Teachers: T. A. Breland, G. Lieblein.
Start term: Spring parallel
Terms: By demand
Prerequisites: The course is open only to students who have completed or are actively following PØL300 (Agroecosystems), PAE302 (Agroecology and Farming Systems) or PAE303 (Agroecology and Food Systems).
Type of course: Individual or group tutorial, ca 20 hours.
Contents: The project work can be carried out individually or, preferentially, in groups of two students. Topics will be chosen either from actual cases at the farm or regional scale or based on the students, individual needs for specific knowledge. The work will include identification of the origin of the project, definition of objectives, a literature study of the state-of-art, an analysis of external and internal factors, choice of study methods, data collection and analysis. If choosing a concrete and complex

situation as study object, the students must be capable of analysing it from several sides and then use the knowledge acquired to propose a realistic improvement. If choosing to review the literature on a specific topic, the students must discuss material from the most relevant and up-to-date references and show how the topic relates to a wider agroecological context. The consequences of solutions proposed to the system concerned and to the environment must be discussed.
Learning goals: Successful students will: A) have an experience of multidisciplinary work within a specific case or an in-depth knowledge based on a literature review of a specific topic related to agroecosystems, B) be able to carry out the synthesis of complex circumstances (comprising productivity, quality, ecosystem services, soil conservation, resource management, economic and social aspects etc.) in a systems perspective, C) be trained in writing synthetic and concise reports.
Methods of examination: Continous assessment **Grading:** A-F
Assessment methods: Written report (80%) and oral presentation (20%).

REIS300 Nature-based tourism

Nature-based tourism

Credits: 10 **Language:** English upon request
Staff/institute: Øystein Aas/ INA
Teachers: Birger Vennesland, Stian Stensland.
Start term: Autumn parallel
Terms: Autumn parallel
Mandatory activities: Excursion: 11-15 September, 2006.
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 goals: 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 **Grading:** A-F
Assessment methods: Project paper (counts 40%) and oral exam (counts 60%).

RØP301 Capital Management in Forestry and Agriculture

Capital Management in Forestry and Agriculture

Credits: 5 **Language:** English upon request
Staff/institute: Torjus Folsland Bolkesjø/ INA
Start term: Autumn parallel
Terms: Autumn parallel
Mandatory activities: Project assignment.
Prerequisites: BUS110, SMI230.
Type of course: Lectures: 26 hours (2 hours per week). Exercises: 26 hours (2 hours per week).
Contents: I Profitability- and income terms - internal interest/profit - nominal - real - income - depreciation - net payment II Value calculations - the current value method - earning requirement (capital cost) for individual projects - utility value/profit value III Taxes - profitability effects of taxation - effective taxation - earning requirements after tax for individual projects IV Uncertainty in investment analyses - attitudes towards risk and uncertainty - portfolio theory and relevant risks - the capital value model - risk compensation - alternatives to uncertainty analysis V General information on value calculations for economic enterprises - balance based methods - earning-based methods VI Value calculations - forest - soil
Learning goals: Students should be familiar with theory and method for analysing different uses of capital on a forest estate, and the potential effects of taxation. Students should know the general theory for economic valuation as well as the relevant principles for valuating forest area in different contexts.
Methods of examination: Final Written exam **Grading:** A-F
Assessment methods: Written examination.
Examination aids: Simple calculator, no other examination aids

SIØ200 Forest Products Marketing

Forest Products Marketing

Credits: 5 **Language:** English
Staff/institute: / INA
Teachers: Heikki Juslin, Jon Bingen Sande, Birger Eikenes
Start term: January block
Terms: January block
Mandatory activities: Professor Juslin's lectures are compulsory.
Prerequisites: AOS120
Type of course: Approx. 50 hours. 6 teaching hours every day the first week (5 days), and 6 teaching hours for 3 days in the third week. The second week is used for self-study.
Contents: Understanding forest products marketing: planning and modelling approach to marketing, the Information Environment Model and its application, Integrated Model of Marketing Planning and its application, structures needed for forest products marketing, the evolution of marketing management, new marketing approaches and their relationship to basic thinking, basic structures of marketing (marketing channels), marketing functions in forest products marketing, marketing communication, functional communication and customer support, product functions as well as different cases: 1. green marketing, 2. ethics and social responsibility in marketing, 3. development of sawn wood marketing in Nordic countries, 4. marketing channels in paper marketing, 5. marketing channels in sawn wood marketing.
Learning goals: Having successfully completed the course, students should know and understand forest products marketing: the global context of forest products marketing, how forest products marketing is carried out as well as the structures needed for a successful marketing approach. The students are to internalise the comprehensive structure of marketing and understand the role of various tools of marketing in that context. The practical aim is that the students should be able to understand their role as marketing practitioners in marketing organisations of forest industry companies.
Methods of examination: Continous assessment **Grading:** A-F
Assessment methods: Student exercises: 40%, final written examination: 60%.

SIØ201 Strategic Planning of Forest Products Marketing

Strategic Planning of Forest Products Marketing

Credits: 5 **Language:** English
Staff/institute: / INA
Teachers: Jon Bingen Sande, Birger Eikenes
First time the course is offered: AUTUMN
Start term: August block
Terms: August block
Mandatory activities: Professor Juslin's lectures.
Prerequisites: SIØ200
Type of course: Approx. 60 hours. 6 teaching hours every day the first week (5 days), and 6 teaching hours for 4 days in the third week. The second week is mainly used for self-study.
Contents: Topics for classroom lectures: Forest industries in global context; recent development/progress of forest industries; strategic planning; concept of strategy; corporate strategic planning; business strategic planning; Porter,s strategy concept; concept of marketing strategy; business strategy vs. marketing strategy; apply the concept of marketing strategy; measuring marketing strategies; strategic planning of marketing; marketing planning as a research and decision making process; use of models in marketing planning; structure for a marketing plan; revealing the planning gap; hypothetical-deductive marketing planning; information in marketing planning; information environment model (IEM); apply IEM; and information sources in marketing planning. Topics for exercises: Norwegian forest sector in a global context; analysing corporate strategies of chosen forest industry companies; writing an outline for 'Marketing development project'; and information sources for a marketing planning project. Case studies: Different ways of going global; conducting a strategic marketing plan and a marketing action plan, perspectives of strategic planning in forest industries.

Learning goals: Having successfully completed the course, students should know and understand the strategy concept and strategic planning on a general level; understand planning of corporate strategy, which makes up the context for marketing strategies; understand how strategic marketing planning works in theory and practice; know what to do step by step when conducting strategic marketing planning; know what sort of information is needed in strategic marketing planning; and know how to plan and execute a study to produce information needed in strategic marketing planning.
Methods of examination: Continous assessment **Grading:** A-F
Assessment methods: Compulsory exercises: 40%, final written examination: 60%.

SIØ302 Forest business II

Forest business II

Credits: 5 **Language:** English upon request
Staff/institute: Birger Eikenes/ INA
Teachers: Anders Qvale Nyrud, Jon Bingen Sande, Birger Eikenes
Start term: Autumn parallel
Terms: Autumn parallel
Mandatory activities: Written assignments.
Prerequisites: SIØ301
Type of course: Lectures, seminars and exercises: 4-6 hours per week.
Contents: There will be emphasis on making the students familiar with the forest sector. Forest sector stakeholders and players are presented through invited guest lecturers and visits. Project assignment: A project is conducted in collaboration with a forest industry business.
Learning goals: The students should gain in-depth knowledge of the international forest sector, and forest products markets and strategic management in forest business. Subjects taught previously in the study will be combined, and the students will do a project assignment where practical and theoretical skills are combined. The students will analyse forest enterprises and forest products markets in order to develop a business plan for a forest indusry company.
Methods of examination: Continous assessment **Grading:** A-F
Assessment methods: Written project report and oral presentation (50%), final oral examination (50%).

STAT300 Statistical Data Analysis

Statistical Data Analysis

Credits: 10 **Language:** English upon request
Staff/institute: Torfinn Torp/ IKBM
Teachers: For exercises, assistant teachers will be present.
Start term: Spring parallel
Terms: Spring parallel
Mandatory activities: Compulsory assignments.
Prerequisites: STAT100, or equivalent.
Credit reduction: ECN201 (5 credits), STAT200 (5 credits).
Type of course: 6 hours of organised teaching per week, for most weeks it will be 4 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: Multivariate analysis of variance, and canonical correlation analysis.
Learning goals: 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: Any calculator, any other 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, STAT210 or equivalent.
Type of course: Lectures and exercises: 6 hours per week.
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 goals: 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: Any calculator, any other 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: Even 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 goals: 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: 3hours.
Examination aids: Any calculator, any other examination aids

STIN340 Computer-intensive Statistical Methods

Computer-intensive Statistical Methods

Credits: 10 **Language:** English upon request
Staff/institute: Ulf Geir Indahl/ IKBM

Teachers: Henrik René Cederkvist.
Start term: Autumn parallel
Terms: Autumn parallel
The course is offered: Even years
Prerequisites: Linear algebra equivalent to MATH130, Statistics equivalent to STAT100, Mathematical statistics equivalent to STAT250, Programming equivalent to INF110.
Type of course: Lectures: 2 hours per week. Exercises: 2 hours per week.
Contents: Core curriculum: Introduction to MATLAB (simulation tool), Introduction to Computer-intensive Statistical methods, Basic probability theory, Sampling, Generation of numbers from random variables. Specialisations (selected from): Monte Carlo methods (including Bootstrapping, Markov Chain Monte Carlo), Density estimation, Statistical pattern recognition, Modern multivariate regression methods.
Learning goals: 1. To give an introduction to modern data-intensive methods within statistics, together with computational tools to handle these. 2. To demonstrate the effectiveness of data-intensive methods in situations where traditional statistical software does not apply.
Methods of examination: Continous assessment **Grading:** A-F
Assessment methods: Oral examination (1 hour - weight 60%). 2 compulsory assignments (weight 40%).

TAT101 Aquaculture Laboratory Course

Aquaculture Laboratory Course

Credits: 10 **Language:** English upon request
Staff/institute: Tor Kristian Stevik/ IMT
Teachers: Asper Jon, Støkken Harald
Start term: Autumn parallel
Terms: Autumn parallel Spring parallel
Prerequisites: Some background knowledge about salmon farming is an advantage.
Type of course: A combination of lectures and exercises: 78 hours in total, divided between autumn and spring.
Contents: The course is a laboratory course with main focus on methods for producing salmon. The students will be guided through a complete production cycle. In laboratory exercises, methods for producing eggs, hatching, start- and growth-feeding are demonstrated and investigated. Furthermore important production factors such as water quality and water treatment, the layout and management of farms, feeding and feeding systems are examined. Special equipment for measuring and monitoring water quality is also demonstrated.
Learning goals: On completion of the course, students should have gained basic knowledge about technology for the production of salmon. Also, they will have good insight into the periods in which the main activities at a fish farm are planned, key elements of these activities, and how they are organised and carried out. The students will also have a good overview and knowledge of important technologies used at fish farms, including equipment for measuring and controlling water quality etc.
Methods of examination: Continous assessment **Grading:** Pass/Fail
Assessment methods: The students are required to carry out and deliver reports for at least 7 sets of exercises in each of the two semesters (14 reports in total). The laboratory exercises and compulsory reports are evaluated and then returned to the students with comments and advice for any required corrections that should be made before the final evaluation.

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
Start term: Spring parallel
Terms: Spring parallel
Prerequisites: AKX100 (production technology part) or TAT 254 or AKX 250
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 in 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 goals: 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 **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 evaluation (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: Harald Støkken, Jon Asper, Odd Ivar Lekang, Tor Kristian Stevik.
Start term: Autumn parallel
Terms: Autumn parallel Spring parallel
Prerequisites: Bachelor or corresponding - Entrance requirement for 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 goals: 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 **Grading:** Pass/Fail
Assessment methods: Continuous assessment, laboratory reports and presentation counts 1/1.

TAT254 Aquaculture Production

Aquaculture Production
Credits: 5 **Language:** English
Staff/institute: Odd Ivar Lekang/ IMT
Teachers: Stevik Tor Kristian, Eriksen Bjørn Frode.
First time the course is offered: SPRING
Start term: January block
Terms: January block
Mandatory activities: Literature studies.
Prerequisites: Bachelor in life science or ongoing Bachelor studies at UMB.
Credit reduction: TAT254 is an integrated part of AKX250 and overlaps 100%. Students that have already passed AKX250 will not be credited extra credits for TAT254. The course also overlaps with parts of AKX100 - Aquaculture (10 credits), but

with higher demands to scientific content. Students that have passed AKX100 and wish to attend TAT254 will only be credited 10 credits in total for both courses (i.e. a reduction of 5 credits for AKX100).
Type of course: Activities consist of lectures and literature studies for a three week period ending with a written exam. In addition, each student will perform an individual written project. The estimated activity includes 8 hours with lectures and theoretical exercises per week + individual literature studies. The individual project is estimated to require one week work.
Contents: In the course there will be lectures in production cycles, manipulating of natural production cycles, farming methods, function and design of major used equipment, water requirement, quality and treatment, farm design for land based and offshore farms. The course is arranged in collaboration with The NOVA Aquaculture and Freshwater Fisheries Education Network (http://www.nova-university.org/novadb/courses/) and is one out of four theoretical blocks of AKX250. Lectures, exercises and literature is parallel with the students participating in AKX250, but the student of TAT254 (this course) will in addition perform an individual project.
Learning goals: The aim of the course is to give the student a knowledge basis in production of fish and the use of technology to achieve an optimal production.
Methods of examination: Continous assessment **Grading:** A-F
Assessment methods: The written exam and the individual project will count 80 % and 20 % respectively of the final grade.

TAT310 Aquaculture Engineering, Main Topic

Aquaculture Engineering, Main Topic
Credits: 15 **Language:** English upon request
Staff/institute: Odd Ivar Lekang/ IMT
Start term: Autumn parallel
Terms: Autumn parallel
Prerequisites: TAT211 - Production technology in aquaculture. TAT230 - Design of Equipment for Aquaculture Facilities, or equivalent prior knowledge.
Type of course: Lectures: 4 hours per week, totalling 52 hours. Exercises and project work with the teacher present: 4 hours per week, totalling 52 hours.
Contents: As part of the course, the students are required to carry out a larger project task within the field of aquaculture engineering. The task will be linked to ongoing projects and research. The students will utilise knowledge from previous courses as well as new knowledge to solve complex problems. New knowledge will be added in fields as planning of fish farms, theory and analysis, choosing locations, describing locations, design and technical descriptions. Furthermore, the students will gain more knowledge about equipment and plants for processing fish. This comprises filleting, skinning, cooling, freezing, smoking and packing of fish. Design and layout for rooms and facilities is also discussed. The students are required to plan a smaller facility for slaughtering/processing of fish.
Learning goals: The students will be able to utilise acquired and new knowledge to solve complex problems related to aquaculture engineering and planning of land-based fish farms. They will also be able to evaluate and determine suitable equipment and process lines for slaughtering and processing of fish.
Methods of examination: Continous assessment **Grading:** A-F
Assessment methods: Final oral exam, approx. 3/4 hours per student. At the oral exam, the candidate is evaluated by a combination of examination in basic theory and defending the compulsory project work and report. Grading of both parts is combined into one grade, where the oral examination counts 2/5 and the defence and quality of the project work count 3/5.

TAT350 Planning and Design of Intensive Fish Farms

Planning and Design of Intensive Fish Farms
Credits: 10 **Language:** English
Staff/institute: Odd Ivar Lekang/ IMT
Teachers: Eriksen Bjørn Frode.
Start term: Autumn parallel
Terms: Autumn parallel
Prerequisites: TAT254 - Aquaculture production, or 211 - Production technology or similar knowledge in the area.

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 goals: 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 **Grading:** A-F
Assessment methods: Final oral exam, approx. 3/4 hours per student. At the oral exam, the candidate is evaluated 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.

THT280 Ecologically Engineered Systems for Waste Water and Waste Treatment.

Ecologically Engineered Systems for Waste Water and Waste Treatment.
Credits: 10 **Language:** English upon request
Staff/institute: Petter D. Jenssen/ IMT
Start term: Spring parallel
Terms: Spring parallel
Mandatory activities: Exercises.
Prerequisites: GEO100.
Type of course: Lectures: 44 hours (11 weeks of 4 hours/week). Exercises (in class): 4 hours. Presentation and discussion of semester assignment: 8 hours. One-day excursion.
Contents: Introduction to natural and recycling (ecosan) systems, for treatment of wastewater, stormwater, landfill leachate and agricultural runnoff. Soil infiltration, bio-filters, wetlands, and pond systems, and solutions source separation. Purification processes in natural systems including pathogen removal. 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 goals: The students shall have an overview of natural and recycling systems for waste water treatment, and have basic knowledge about design and dimensioning of treatment systems based on local conditions.
Methods of examination: Continous assessment **Grading:** A-F
Assessment methods: Written examination: 3 hours, counts for 3/4. Project assignment counts for 1/4.

THT281 Decentralised Wastewater Treatment? Appropriate Sanitation in Developing Countries

Decentralised Wastewater Treatment? Appropriate Sanitation in Developing Countries
Credits: 5 **Language:** English
Staff/institute: Petter D. Jenssen/ IMT
Start term: August block
Terms: August block
Mandatory activities: Exercises.
Prerequisites: THT280.
Type of course: Lectures: 35 class hours. 5 days of 7 hours per day. Demonstrations: 4 class hours. 2 days of 2 hours per day.
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 goals: 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: Continous assessment **Grading:** Pass/Fail
Assessment methods: Semester assignment.

THT282 Ecotechnology Basics

Ecotechnology Basics
Credits: 15 **Language:** English
Staff/institute: Petter D. Jenssen/ IMT
Start term: Autumn parallel
Terms: Autumn parallel
Prerequisites: Basic knowledge of geology, microbiology, chemistry equivalent to GEO100, BIO130, KJM100.
Type of course: Lectures: 48 class hours. 4 hours per week. Discussions and exercises: 32 class hours. Short, local excursions.
Contents: The course will cover the basic concepts for understanding of ecologically engineered systems. Key concepts: biogeochemical cycling, analysing life cycles, watershed management, groundwater hydrogeology, examples of state-of-the art ecotechnology. It will also deal with the interrelationships to the institutional and social setting, the constraints and potentials due to design of nature-based systems and the effects on sustainability.
Learning goals: The students shall upon completion of the course have knowledge about the principles of ecological engineering and be able to elucidate the connection to nature and society in the design of decentralised systems for water supply, bioenergy and recycling of organic waste and wastewater. The students shall have the basic knowledge needed to understand design of systems for groundwater supply, bioenergy and recycling organic waste and wastewater.
Methods of examination: Continous assessment **Grading:** Pass/Fail
Assessment methods: Exercises.

THT299 Environmental Engineering, Project Work

Environmental Engineering, Project Work
Credits: 5 **Language:** English upon request
Staff/institute: Jarle Tommy Bjerkholt/ IMT
Teachers: Oddvar Lindholm, Petter Jenssen, others.
Start term: August block
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 goals: 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 Ecological and Conventional Systems for Treatment of Water

Ecological and Conventional Systems for Treatment of Water

Credits: 15 **Language:** English upon request
Staff/institute: Lasse Vråle/ IMT
Teachers: A. Heistad, H. Ratnaweera, L. Vråle.
Start term: August block
Terms: August block Autumn parallel
Mandatory activities: Exercises.
Prerequisites: THT280 and THT271 or THT282.
Type of course: Lectures: 66 hours. (6 hours per week for 11 weeks). Review of exercises: 4 hours. Presentation and discussion of a semester project: 12 hours. A 2-day 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. I 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 and the semester assignment, students will gain experience which prepares them for professional work. The course also contains 2-4 days of field work and a two days excursion.
Learning goals: 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.
Methods of examination: Continous assessment **Grading:** A-F
Assessment methods: Oral examination, 45 minutes, 3/4. Project assignment 1/4.

TMP301 Machinery and Product Development

Machinery and Product Development

Credits: 15 **Language:** English upon request
Staff/institute: Tor Anders Nygaard/ IMT
Teachers: Bøe, Jan Kåre and Stemsrud, Egil.
First time the course is offered: AUTUMN
Start term: August block
Terms: August block Autumn parallel
Mandatory activities: All compulsory exercises which are part of the august block shall be handed in and approved by the end of September. Approval is only valid for one calendar year.
Prerequisites: Students must have gained the necessarry knowledge in materals technology and engineering, calculation and sizing of machinery parts, technical design and FEM-analysis, either by the relevant TMP200 courses or by similar education and/or experience.
Type of course: August block: Lectures: 24 hours, 6 hours per week, Exercises: 20 hours, calculation exercises and laboratory work (guided)4 hours per week. Autumn parallel: Lectures: 36 hours. Week 36-41: 3+3 hours per week. Exercises; 24 hours, Week 40-46: 4 hours per week. Project paper: 30 hours, Week 38-49: 2-4 hours per week (plus homework), with academic supervision.
Contents: The course has four phases: Part 1. Basic design (August): Central topics are technical standards, stress and safety calculation for complex parts, the choice of materials and design based on functional, environmental and aesthetical requirements, production and joining methods, finish and surface protection, traditional and CNC-controlled production technologies, Part 2. Advanced design and optimization: Central topics are safety calculation and testing methods for complex constructions and assemblies, non-linear deformation processes, dynamic loading, fatigue, energy absorption and lifetime calculations, industrial ecology, This part also includes more advanced training in FEM-analysis/calculation programs. Part 3: Project planning: Planning, organising, carrying through and reporting a development process, rules, systems and guidelines. Part 4. Compulsory project work: A limited design and product development project is carried through with the submission of a report/disc containing all necessary backgrounds, calculations and descriptions for the manufacturing of a prototype. The projects are to a large extent carried out in cooperation with enterprises, or as an early phase in technology development at the department.

Learning goals: Students are to gain competence in projecteering, calculation, design and visualization of complex machinery- and process-technical constructions, and in the use of computer based design and production technologies. The students are to practice development cooperation, enterprise cooperation and important elements of small-scale industrial production of new products. After having completed the course, the student is to have knowledge on methods for calculating the properties of materials, strength and lifetime of various types of constructions and evaluate results from complex calculations and analysis tools. They are to be able to make choices concerning design and materials from considerations of strength, economy and environment and give advice on the technical aspects of production. Also, they are to have good knowledge of modern computer assisted production methods for different product categories. Through the course, the students are to gain abilities that make them suited for conducting every engineer-technical phase in a product development project, individually or in teams with others. They are to be able to plan, conduct, calculate, visualize and report a new technological product with production instructions. Throughout the course, there is a focus on the effects of technology on the environment and on human beings, among other things through the use of energy, material ecology and pollution aspects.
Methods of examination: Continous assessment **Grading:** A-F
Assessment methods: Oral exam: Project presentation with examination, counts 50%. Project work: Project report with appendixes, counts 50%. Continuous assessment: All smaller tests during the august block has to be approved (by the end of September) before the final examination. The project work must be completed one week before entering the final oral examination. The oral examination consists of an assessment of theoretical knowledge as well as a presentation and discussion of the project work. The project work is assessed on basis of a set of criteria which are available to the student.

TMPP212 Biological Material Science

Biological Material Science

Credits: 10 **Language:** English
Staff/institute: Johan Andersen/ IMT
Teachers: Wicklund, Trude.
Start term: Autumn parallel
Terms: Autumn parallel
Mandatory activities: One of the laboratory exercises and one of the written project papers are compulsory.
Prerequisites: Bachelor's degree or; General chemistry at the level of KJM100, Physics at the level of FYS100 and Mathematics at the level of MATH010.
Type of course: Lectures: 52 hours, 4 hours per week. Self-study and group work: 52 hours, 2 hours per week. Laboratory exercises: 20 hours.
Contents: Part 1: Synthetic polymers (Plastics and rubbers). Structures of polymers, the affect of molecular bindings on mechanical properties. Resistance to denaturising related to water and chemicals. Structure, properties and application of composite materials. Part 2: Biopolymers (Proteins and polysaccharides). Structures of proteins, the affect of molecular bindings on mechanical properties. Resistance to denaturising related to water and chemicals. Part 3: Viscoelasticity in biomaterials (Dynamic- and mechanical properties). Part 4: Cereals as raw material in feed products. Characterisation of basic components and there transformations in processes like extrusion, pelleting, expanding, and how these processes change the properties of the raw materials.
Learning goals: The aim is to build up basic knowledge about why materials with a biological origin have some specific mechanical properties. These properties are measured as a response of some known external force, and the topic is called Rheology. One example is cereals as raw material in feed products. How these properties will be affected by water content, temperature and pressure is important. The student shall gain material technology knowledge which links the properties of single material components to the properties of a mixed multi-component material focused on the bindings between molecular structures. The mechanical properties should be expressed in notions with reference to physics, chemistry and mathematics. It is important to gain knowledge about how to describe and classify biomaterials and to be aware of the similarities in properties between synthetics and biologic polymers.
Methods of examination: Continous assessment **Grading:** A-F
Assessment methods: The continuous assessment is based on a personal written report and common tests.

TMPP250 Process Technology I

Process Technology I

Credits: 5 **Language:** English upon request
Staff/institute: Johan Andersen/ IMT
Teachers: Haugen, Finn.
Start term: Spring parallel
Terms: Spring parallel
Mandatory activities: Two laboratory exercises.
Prerequisites: FYS112 - Mechanics and Thermophysics, MATH111 - Calculus I, MATH112 - Calculus II. Alternative: Bachelor's degree in Engineering (special criteria for the Master's degree in Feed Manufacturing Technology).
Type of course: Lectures: 32 hours, 3 hours per week. Group work, laboratory exercises and self-study with supervision: 26 hours, 2 hours per week.
Contents: The first part gives review and some further insight within the topic of heat- and mass transport in closed systems like pipes, tanks etc. Then detailed descriptions of common used processes like: heating, cooling, drying, humidification, and processes related to humid air and steam are given. The third topic is related to principles and quality specification of instruments, and how these will affect a control or supervision system. Based on the above topics a introduction in control engineering and building of mathematic models are given. Tuning and stability calculation related to the PID-controllers is also addressed. The last topic is related to Programmable logical control (PLC) used in many applications like sequential on and off control of a large number of signals/switches. Different types of software are used; like MATLAB and Lab View.
Learning goals: Students should be able to use technical terms and calculation methods within the topic; Mass- and heat transport in process equipments based on specified requirements and conditions. They should be able to develop mathematical models which describe the relationship between the important parameters in the process. Priority is given to practical application of basic subjects like mathematics, chemistry and physics. Furthermore, the students should gain experience in how to develop control and supervision systems for machines and process equipment. It is important that the students learn to look upon themselves as specialists in one narrower field, and that they will be able to solve a broader problem by working in a team.
Methods of examination: Continous assessment **Grading:** A-F
Assessment methods: Continuous assessment.

TMPP350 Process Technology II

Process Technology II

Credits: 15 **Language:** English upon request
Staff/institute: Johan Andersen/ IMT
Teachers: Haugen, Finn.
Start term: Autumn parallel
Terms: Autumn parallel
Mandatory activities: The submission of two assignments is a compulsory part of the course. Also, journals/other assignments from the laboratory/group exercises must be approved.
Prerequisites: MATH112 - Calculus II, FYS112 - Mechanics and Thermophysics, TEL230 - Control Engineering, TMPP250 - Process Technology I, or equivalent.
Type of course: Lectures: 42 hours, 6 hours per week during the first 7 weeks. Group work, laboratory exercises and project assignments: 90 hours, 6 hours per week for 15 weeks.
Contents: The students get practice in the use of numerical models in the fields of thermodynamics and fluid dynamic software for calculations of heat and mass transfer (3 credits). The following topics in advance control engineering and leadership of development project (6 credits): Model based prediction control (MPC), Statistical process control (SPC), Process optimisation, Batch processes, Neural networks, Fussy logics, Quality control, Production planning, Feasibility studies. Two tasks project work primarily in cooperation with the industry (6 credits).
Learning goals: 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. They should know how to lead a production

unit of a factory according to set of specified goals. 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 engineering.
Methods of examination: Final Oral exam **Grading:** A-F
Assessment methods: Oral exam, approx. 45 minutes.

TPS220 Bulk Solids Handling

Bulk Solids Handling

Credits: 5 **Language:** English
Staff/institute: Johan Andersen/ IMT
Teachers: Carlos Salas.
Start term: Autumn parallel
Terms: Autumn parallel
Mandatory activities: Laboratory exercises are compulsory.
Prerequisites: General chemistry equivalent to KJM100 - General Chemistry. Physics equivalent to FYS 100 - Physics and Nature.
Type of course: Lectures: 26 hours, 2 hours per week. Laboratory exercises: 12 hours, 2 hours per week.
Contents: Mechanical properties of granular materials. Fractioning and Weibull analysis. Transport of solid bulk materials. Design of different types of transport systems with emphases of pneumatic conveying and fractioning of products during transport. Segregation and mechanisms related to this phenomenon. Methods for design of silos. Flow patterns inside silos.
Learning goals: On completion of the course, the students should be able to carry out measurements of parameters related to technical quality of bulk solids, based on production process knowledge of granulated biological raw materials. Be able to describe the physical mechanisms related to fraction of particles and segregation of particles of different sizes. Complete design of systems for transport and storage of bulk solid materials.
Methods of examination: Continous assessment **Grading:** A-F
Assessment methods: Continuous assessment.

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 goals: 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 are also to 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 **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.

ØXX230 Evolutionary Biology

Evolutionary Biology

Credits: 10 **Language:** English upon request
Staff/institute: Øystein Holand/ IHA
Start term: Spring parallel
Terms: Spring parallel
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: An even distribution between lectures and student presentations with discussion.
Contents: All information concerning lectures, exercises, presentations etc. will be available on the website in due time.
Learning goals: 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 macroevolution. 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

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