SDC

The university partnership
Denmark – China

Course Catalogue Spring 2022

All courses related to the
SDC programmes

Contents

Chemical and Biochemical Engineering

Green Chemical Engineering

5 ECTS

Course coordinator: Xingmei Lu, xmlu@ipe.ac.cn

AIM (general objectives):

This course will provide comprehensive knowledge of new development of green chemistry and green chemical engineering with focus on green catalysis, green synthesis and materials.

CONTENT

- Introduction to Green Chemical Engineering
- History of Green Chemical Engineering
- Catalysis in Green Chemical Engineering
- Green Chemical Engineering in organic synthesis
- New green materials
- Green materials design

LEARNING OBJECTIVES

At the end of the course, the students should be able to:

- understand the basic concept of green chemical engineering and state of the art of research and application.
- carry out basic approaches of design catalysts for application to green chemical engineering.
- make the preliminary design of a green process.

EXAMINATION

2 course assignments of 4-6 pages each are to be solved individually. The final marks are given based on the marks of the course assignments (50 % each).

RE-EXAMINATION

The same as the ordinary exam.

GRADING

Grades are given according to the Danish 7 step and the Chinese 100 points grading scales.

Process Design – Principles & Methods

10 ECTS

Course coordinator: Jakob Kjøbsted Huusom jkh@kt.dtu.dk

CONTENT

The course will be divided into two parts.

The first part will deal with introduction to process design principles, the stages of the process design life cycle and the preliminary design steps (flow sheet synthesis, equipment sizing/costing, economic evaluation, scheduling of batch operations, distillation sequences, and pinch analysis).

The second part will deal with conceptual design (advanced process synthesis (such as heat integration, heat exchanger networks, reactor networks, reaction-separation sequences, and solvent selection), equipment selection, and flow sheet optimisation).

LEARNING OBJECTIVES

At the end of the course, the students should be able to:

- make design related decisions.
- use knowledge to solve practical engineering problems.
- collect and assess missing data and information from the open scientific literature.
- work in groups.
- use computer aided tools.
- generate and screen alternatives.
- verify and analyse simulation results.
- formulate process design problems and to develop systematic solution strategies.
- apply chemical engineering principles learned from other courses.
- apply "green" or environmental issues in process design.

EXAMINATION

Evaluation of design project report plus oral presentation of design status.

RE-EXAMINATION

The same as the ordinary exam.

GRADING

Grades are given according to the Danish 7 step and the Chinese 100 points grading scales.

Coatings Science and Technology

7.5 ECTS

Course coordinator: Huichao Bi hubi@kt.dtu.dk

AIM (general objectives):

By the end of this course, it is expected that the students get the basic knowledge on coatings, can choose the raw materials and do simple coating formulation for a certain coating application. It is further aimed at getting the students prepared for working in the industry with industrial standards and application examples demonstrated in the course.

CONTENT

This course will give a broad perspective on coatings science and technology, covering the whole life cycle of coatings. It consists of theoretical lecturing and laboratory experiments. Topics covered by the theoretical part include Introduction to Coatings, Raw Materials, Coating Formulation, Coating Production, Coating Application, Coating Testing and Inspection, Challenges and Outlook in the Coatings Industry. The experimental part is comprised of laboratory experiments in coating system formulation, coating application and coating testing, including testing of physical, mechanical, and chemical properties of coatings, such as dry film thickness, adhesion, hardness and anti-corrosive performance, etc.

LEARNING OBJECTIVES

A student who has met the objectives of the course will be able to:

- identify the roles of the components in a coating system.
- demonstrate the coating film formation and crosslinking mechanism.
- estimate solvent properties and analyse rheological phenomena in coatings.
- characterize pigments and pigment dispersion.
- select relevant coatings standards and test protocols.
- do basic coating system specifications for the heavy-duty industry, including coating formulation, common surface preparation and application techniques.

EXAMINATION

The theoretical part is evaluated based on a 4-hour written exam (70%) and the laboratory experimental part is evaluated based on a full report covering the lab exercises 1 to 7 containing a description of execution, results and conclusions (30%). All aids are allowed in the final written exam, except for web-access.

Note: Due to the COVID-19 situation, the laboratory experimental part for the year 2022 will be replaced by a report submission (individual report, no less than 10 pages, the topic for the report will be sent out by the teacher after the theoretical part lecturing).

RE-EXAMINATION

Oral exam. Questions based on the topics delivered in the course will be asked. The total evaluation is 20 minutes. No aids are allowed.

GRADING

Grades are given according to the Danish 7 step and the Chinese 100 points grading scales.

SDC Green Challenge

5 ECTS

Course coordinator: Hao Wu haw@kt.dtu.dk

AIM (general objectives):

To train the students to conceive, design, implement and operate sustainable solutions to energy and environment challenges.

CONTENT

This course will provide the students an opportunity to use their knowledge obtained from the SDC MSc Program in Chemical and Biochemical Engineering to identify an energy or environment related challenge in China or Denmark, to develop a concept addressing the challenge, and to evaluate the feasibility of the concept with respect to technology, economy and sustainability.

LEARNING OBJECTIVES

At the end of the course, the students should be able to:

- identify and analyse an energy or environment related challenge in China or Denmark.
- conceive chemical and biochemical engineering solutions.
- develop a solution concept to the point where the feasibility of the concept can be decided.
- evaluate the technical, economic and sustainable aspects of the solutions.
- present the results to non-specialists and participate in scientific/non-scientific discussions.

EXAMINATION

The students will work in teams of four students. Each team must:

1) participate in the GRØN DYST at DTU (if online participation is allowed), including submitting an abstract and presentation to the conference.

2) complete a report for the developed project for GRØN DYST. The report is expected to be 10-15 pages and be submitted at the end of the course.

The course is evaluated based on the report (50%) and an individual presentation of the GRØN DYST project at the oral exam (50%). The duration of the presentation is 5 minutes, followed up by a discussion/question session of 5 minutes.

RE-EXAMINATION

The re-exam consists of re-submission of the report and an individual oral exam following the same rule as the ordinary exam.

GRADING

The course is evaluated according to pass/non-pass.

Summer School in Unit Operations

5 ECTS

Course coordinator: Hao Wu haw@kt.dtu.dk

AIM (general objectives):

To show the possibilities and limitations of the theory and achieve practical experience and improved understanding of the Chemical and Biochemical Unit Operation processes. This is performed by experiments in technical pilot with process equipment, which is used in the chemical, biochemical and pharmaceutical industry.

CONTENT

3-week experiments and visits to companies and chemical plants. During the 3-week period, in groups of two, the students perform and report on four exercises within the following areas: flow in pumps, pipes and fittings, flow through particle beds, heat transmission, distillation, absorption, extraction, filtration, membrane filtration, centrifugation, drying, evaporation/crystallization, agitation.

LEARNING OBJECTIVES

At the end of the course, the students should be able to:

- apply the theory in unit operations to practical experimental problems.
- analyse results and formulate conclusions concerning the quality and applicability of the results and to draw consequences for the process operation, plant design and functionality of the components.
- operate process units incl. data acquisition systems and measuring equipment in pilot scale size.
- explain the design of processes.
- recognise technical components on real life plants.
- identify and explain practical tasks concerning sampling and measuring techniques.
- make a report on an experimental job in an organised way, which makes it easy to read and understand calculations on conclusions.

EXAMINATION

The course is evaluated based on the four reports (in a group of two students) on experiments. The reports must be done according to a report writing guide provided by the teacher. Contributions of individual students must be specified in the reports.

RE-EXAMINATION

Individual reports must be completed before the re-exam. Passed reports will be transferred to the re-exam.

GRADING

Grades are given according to the Danish 7 step and the Chinese 100 points grading scales.

SDC Research Immersion

5 ETCS

Course coordinator: Hao Wu haw@kt.dtu.dk

AIM (general objectives):

Through participation in a research project in a shorter period, the student will try to answer a question or solve a problem, which is connected to the work of the supervisors. The student will gain knowledge within a topic related to the research area of the Department of Chemical & Biochemical Engineering, while gaining insight into how the scientific method is put into practice to solve a given problem. The student will also gain general competences, e.g., the ability to participate in constructive mentor-mentee relationships and the ability to communicate science – in writing as well as orally.

CONTENT

Participation in a research project in collaboration with supervisors. The supervisors can be professors, researchers, postdocs or PhD students at DTU Chemical Engineering. The exact content of the project will be further agreed upon with the supervisors. The project must be communicated in a final, written report.

LEARNING OBJECTIVES

A student who has met the objectives of the course will be able to:

- work in a focused and strategic manner to retrieve scientific literature.
- extract information from scientific articles of relevance to a scientific project.
- critically evaluate his/her own and others experimental designs.
- Plan and carry out and finalise a project under tight time constraints.
- communicate the results of a scientific project in a report that could be shaped like a scientific article.
- constructively participate in a student-supervisor relationship.
- explore and analyse relevant technologies for solving the given problem.

EXAMINATION

The course is evaluated based on a final, individual written report. The length of the report should be 15-30 standard pages (excluding appendices).

RE-EXAMINATION

The same as the ordinary exam.

GRADING

Grades are given according to the Danish 7 step and the Chinese 100 points grading scales.

Note: This course is only offered to SDC students who have taken a laboratory course in unit operations at DTU Chemical Engineering during bachelor study. This course is also offered for students that cannot travel to Denmark for the Summer School in Unit Operations.

Thesis (4. Semester)

30 ECTS

Course coordinator: Hao Wu haw@kt.dtu.dk

The MSc thesis aims to give students the opportunity to apply the knowledge they have acquired in an independent way on a larger project that concludes with a written report. The thesis must document skills in applying scientific theories and methodologies to a clearly defined academic topic. The thesis must fall within the technical and scientific field of the programme.

CONTENT AND LEARNING OBJECTIVES

The thesis may contain a combination of experimental work, fieldwork, theoretical studies, synthesis, modelling and analysis. The thesis must include elements of literature studies and criticism. In addition, the thesis contains the following overarching learning objectives.

A graduate of the MSc programme in Chemical and Biochemical from SDC:

- can identify and reflect on technical scientific issues and understand the interaction between the various components that make up an issue.
- can, based on a clear academic profile, apply elements of current research at international level to develop ideas and solve problems.
- master's technical scientific methodologies, theories and tools, and has the capacity to take a holistic view of and delimit a complex, open issue, see it in a broader academic and societal perspective and, on this basis, propose a variety of possible actions.
- can, via analysis and modelling, develop relevant models, systems and processes for solving technological problems.
- can communicate and mediate research-based knowledge both orally and in writing.
- is familiar with and can seek out leading international research within his/her specialist area.
- can work independently and reflect on his/her own learning, academic development, and specialisation.
- masters technical problem-solving at a high level through project work and has the capacity to work with and manage all phases of a project – including preparation of timetables, design, solution and documentation.

EXAMINATION

The thesis is an individual written assignment. The length of the thesis is 60-100 standard pages.

The MSc thesis is evaluated based on a report and an oral defence. In assessment of a MSc thesis, the quality of the academic contents will carry the most weight. The students writing abilities will also count, though this will be weighted slightly less, while spelling will carry little weight.

The duration of the oral examination is 60 minutes excluding grading. The students have maximum 20 minutes to do a presentation of the thesis.

The grade awarded reflects an overall assessment of the written thesis and the oral defence.

The assessment is made by the Thesis Defence Panel, which includes an external examiner.

RE-EXAMINATION

Re-examinations are subject to the same regulations as the ordinary exam

A revised version of the thesis can be based on a new or revised subject.

GRADING

For the Danish/international students, grades are given according to the Danish 7 step and the Chinese 4 step thesis grading scales.

For the Chinese students, grades are given according to the Danish 7 step grading scale only.

The details of the thesis procedure are described in SDC Thesis Regulations 10 Steps.

Innovation Management

Product Design and Development

7.5 ECTS

Course coordinator: Dmitrij Slepniov, Associate Professor, Aalborg University (ds@business.aau.dk)

CONTENT

The aim of the module is to provide the students with a systematic process, a set of tools and methods that will enable them to understand how design ideas may evolve into innovative solutions to marketplace needs, wants and desires.

The creation of a new product or service is not a simple process. It takes in various organisational levels, numerous functional areas, dispersed geographies and requires unique skills and competences of the individuals involved in it. This course combines the perspectives of marketing, design and operations. In addition to focusing on the design and development phases a product goes through, the course also addresses a more general view of the appropriate attitude to design and innovation in today's fast changing global business environment.

LEARNING OBJECTIVES

Following the successful completion of the module, the students will be able to:

- gain knowledge and understanding of characteristics of successful product design and development.
- grasp what it takes to create a new product or service and what are fundamental design techniques in demand methodologies that support this process.
- develop ability and confidence in adopting, evaluating and implementing design techniques and methodologies in various domestic and international organisational settings in both manufacturing and service environments.

EXAMINATION

Individual written assignment (individual 5-7 pages product design brief (excluding bibliography or supplementary material such as appendices, prototype specifications, etc.) based on the course syllabus and specified cases to be used as an empirical foundation for the assignment.

RE-EXAMINATION

Re-examination is subject to the same regulations as the ordinary exam.

GRADING

Grades are given according to the Danish 7 step and the Chinese 100 points grading scales.

Innovation Systems and Government-Business Relations

5 ECTS

Course coordinator: Rasmus Lema, Assistant Professor, Aalborg University (lema@business.aau.dk)

CONTENT

The aim of the module is to provide students with knowledge of theories of innovation systems and how companies are embedded in and can take advantage of such systems. Technology is seen as the key driver in most frameworks and thus technological development and its impact on socio-economic change are at the core of this course.

The module will have a special focus on government-business relations, including policies of innovation promotion and university-business relations, and on how new technologies are developed in such an interaction context.

The module will present contemporary theories of innovation systems in different perspectives (Global, National, Regional, Sectoral, Technological) and will illustrate their interplay with innovation at business- and organizational levels. Innovation systems will furthermore be analysed from a policy perspective, in order to support the development of innovation systems.

While the focus will be on innovation system variants, we will also explore several ecosystem frameworks (i.e. business, innovation, knowledge, entrepreneurial ecosystems) that have been prominent within the business- and management literature.

The course will have a considerable number of practical elements, where we will explore different techniques for system mapping and analysis, such as qualitative event analysis, network analysis and various data mining techniques.

LEARNING OBJECTIVES

Following the successful completion of the module, the students will be able to:

- analyse and reflect on the concept of innovation systems and apply it at different analytical levels.
- conduct analysis and evaluation of innovation systems' development, dynamics and opportunities for change through policy formulation.
- understand and reflect on innovation management strategies within an innovation system perspective.
- account for and explain the roles of government in business activities of firms.
- understand and critically assess different strategies that businesses can pursue in relation to governments.

EXAMINATION

The course is evaluated through a written assignment. The length of the essay is 7-10 standard pages (including references, tables etc.)

RE- EXAMINATION

Re-examination is subject to the same regulations as the ordinary exam.

GRADING

Grades are given according to the Danish 7 step and the Chinese 100 points grading scales.

Globalisation and Innovation

5 ECTS

Course coordinator: Dmitrij Slepniov, Associate Professor, Aalborg University (ds@business.aau.dk)

CONTENT

The aim of the module is to give students knowledge on theories of economic globalisation in general and specific theories of internationalisation of companies focusing on the internationalisation of value chain activities in general and innovation activities in particular.

The focus of the module is on the internationalisation of innovation/R&D and how global innovation networks are organised and managed in an intercultural context. Furthermore, a special attention is given to the subject of managing knowledge and intellectual property rights in a global context.

Teaching comprises lectures, seminars and cases. Furthermore, the theoretical elements of the course are linked to practical action through a written group assignment that is performed throughout the course.

LEARNING OBJECTIVES

Following the successful completion of the module, the students will be able to:

- understand and reflect on the major dimensions, stages, drivers and meanings of globalisation.
- understand and reflect on how companies fit within the context of globalization and organise their value chain activities across borders.
- critically ponder and synthesize internationalisation theories in relation to their value chain activities in general and innovation/R&D activities in particular.
- use tools and techniques needed for organising innovation activities on the global scale.

EXAMINATION

Individual written exam based on a written case-based assignment and the course syllabus. Assignment length 7-10 standard pages (excluding bibliography and appendices).

RE- EXAMINATION

Re-examination is subject to the same regulations as the ordinary exam.

GRADING

Grades are given according to the Danish 7 step and the Chinese 100 points grading scales.

Business Models Innovation

12.5 ECTS

This includes Semester Project II

Course coordinator: Christian Byrge, Associate Professor, Aalborg University (post@christianbyrge.com)

CONTENT

The aim of the module is to provide students with insights into the concept of business models and how to design and implement business models as well as how to design and implement original, unique and innovative business models. Furthermore, the module is set out to provide the students with contemporary creativity approaches for enhancing creativity in the entrepreneurial team and for the entrepreneurial individual. A concrete case related to innovation, business modelling and creativity is used to experiment on and discuss the development of business models.

LEARNING OBJECTIVES

Following the successful completion of the module the students will be able to:

- understand and reflect on business models, innovation and its underlying assumptions.
- understand and practice contemporary approaches for enhancing creativity and how to apply creativity methods in teams and for individuals.
- link business model theories to innovation and creativity practices and use tools for business model innovation.

EXAMINATION

The examination in this course is integrated with the examination in *Semester Project II* and an overall grade will be given. For examination regulations please see *Semester Project II*.

Semester Project II

12.5 ECTS

This includes the course Business Models Innovation

Course coordinator: Dmitrij Slepniov, Associate Professor, Aalborg University (ds@business.aau.dk)

CONTENT

The aim of the module is to further develop (from Semester Project I) the students' skills in working problem-oriented in groups and solve real-life innovation problems.

The module is based on identifying and analysing real-life innovation problems. The identified problem must be addressed by an activation of the theoretical insights gained in other modules and the methodological learnings from the module Research Methods. The students will be provided with guidance/supervision throughout the project period.

The theme for Semester Project I is the innovation problems and issues faced by companies and societies today as they were presented and discussed in the previous modules of the 2nd semester. The semester project is expected to deal with an issue related to the previous modules and adopt a perspective related to innovation management as presented in the module Business Models Innovation.

Students work in groups and each group is assigned a supervisor for discussing the topic to work on and subsequently supporting the group in relation to data collection, analysis, theoretical reflections and solutions.

The topic for the semester project is chosen by the students in consultation with supervisors and approved by the coordinator. The topic must be a real-life problem to allow for theory-practice integration. Furthermore, it must be a problem that can be properly researched within the available period of the Semester Project II. Collaboration with companies is encouraged but should be discussed with the supervisor to make sure that it is realistic to collaborate and compile the necessary data within the given period of the module.

LEARNING OBJECTIVES

Following the successful completion of the module, the students will be able to:

- formulate a complex problem in innovation/innovation management with basis in reality highly exposed to global trends.
- analyse the formulated problem using practical insights, scientific methods and theoretical reflections from the modules of the semester.
- prepare and execute the empirical part of the project (data selection, collection and analysis) using the Methodology module.
- develop solutions to the problem and communicate these through a project document.
- experience and advance their understanding of working in diverse intercultural groups.

EXAMINATION

Individual oral examination based on a written project.

The project is prepared in groups (recommended group size is 4-5 students). The length of the project is

min. 30 and max. 50 standard pages. Standard page is defined as 2400 characters including the spaces

between words. The stipulated number of pages excludes annexes and reference list, but includes tables

and figures.

The individual oral exam is 25 minutes per student (incl. grading) based on a written project. The

examination also includes the module in Business Models Innovation.

RE-EXAMINATION

Individual oral examination based on a written project. The project is an individual written mini-project of 10 standard pages. Standard page is defined as 2400 characters including the spaces between words. The stipulated number of pages excludes annexes and reference list but includes tables and figures. The oral exam is 25 minutes (incl. grading).

GRADING

Grades are given according to the Danish 7 step and the Chinese 100 points grading scales.

Thesis (4. Semester)

30 ECTS

Course coordinator: Dmitrij Slepniov, Associate Professor, Aalborg University (ds@business.aau.dk)

CONTENT

The aim of the thesis work is to demonstrate that the student can work on a high theoretical level and in a systematic manner apply scientific methods to problems within innovation management that are theoretical or practical in nature. The thesis must demonstrate competence working with scientific theories and methods within a specified subject of innovation management. The subject must have a complexity and an extent that allows for it to be completed in course of one semester.

The thesis may be theoretical or theoretical/practical in nature. Students may establish a partnership with a company or an organisation with the purpose of identifying and solving problems within management of innovation using scientific procedures and methods. The students will be provided with guidance during the thesis, having a Danish as well as a Chinese supervisor.

LEARNING OBJECTIVES

After having completed the master's thesis, the student must be able to:

- identify and define a complex and relevant innovation management problem (theoretical or theoretical-practical in nature) with important practical (policy and/or strategic) implications and potential for theoretical contribution.
- identify and apply relevant theories that can be used for building a conceptual framework for the analysis of the identified innovation management problem.
- identify and compare relevant scientific methods and prepare a design for selection, collection and analysis.
- develop solutions and demonstrate implications based on the findings of the analysis
- work independently and assume academic responsibility for the learning that the project has resulted in.
- demonstrate competence of and skills in scientific writing and oral presentation of the thesis and its findings.

EXAMINATION

The thesis is an individual written assignment.

The thesis has a length of a minimum of 60 and a maximum of 100 standard pages, excluding executive summary, references and annexes. Students should add a summary to the thesis in English.

The examination (defence) is oral, based on the thesis. It consists of the thesis presentation followed by a dialogue between the student and the examiners that make up the Thesis Defence Panel.

The oral examination lasts 60 minutes (incl. assessment).

The grade awarded must reflect an overall assessment of the written thesis and the oral defence.

The assessment is made by the Thesis Defence Panel which includes an external examiner.

RE-EXAMINATION

Re-take examinations are subject to the same regulations as the ordinary exam. For more information, see SDC Thesis regulations 10 steps.

GRADING

For the Danish/international students, grades are given according to the Danish 7 step and the Chinese thesis grading scales.

For the Chinese students, grades are given according to the Danish 7 step grading scale only.

The details of the thesis procedure are described in SDC Thesis Regulations 10 Steps.

International Food Quality and Health

Food Toxicology

3.75 ECTS

Course responsible coordinator: Prof. Qunfang Zhou

COURSE CONTENT

This course aims to provide a broad foundation of knowledge and overview of major existing and newly emerging items of concern within the field of food toxicology and food safety assessment. Food toxicology is the study of the nature, properties, effects, and detection of toxic substances in food, and their disease manifestation in humans. From health and economic consequences to exposure assessment and detoxification, this course comprehensively covers dose-response relationships, absorption, distribution and storage, biotransformation and elimination of toxicants, target organ toxicity, teratogenesis, mutagenesis, carcinogenesis, food allergy, and risk assessment. The chemical substances presenting in traditional and novel foods, including natural toxins, food supplements, substances derived from food processing, agricultural chemicals, persistent organic pollutants, engineered nanomaterials, food additives, and veterinary drugs, will be described, regarding how they are produced, tested and regulated. Various antioxidants and essential metals in food will be introduced, regarding their roles against or for free radical induced damage to macromolecules. The underlying mechanisms for the toxic substances in food and the related methodologies will be discussed. The related interesting references, as well as recent guidelines from U.S. Food and Drug Administration (FDA), World Health Organization and China regarding food hygiene and safety, will be included to facilitate the understanding of the current situation in food management and further research.

LEARNING OUTCOMES

Knowledge

During the course, the students will gain knowledge in and understanding of:

- basic concepts for toxicology and food toxicology.
- naturally occurring and man-made toxins in food.
- antioxidants and essential metals in food.
- toxicological effects of foodborne toxins.
- cell signalling pathways involved in food toxicology.

Skills

The students will be able to:

- help develop critical thinking skills about the risks of foodborne toxicants and understand the importance of the lessons learned for the scientific work and future career.
- identify the risky chemicals in food and their sources
- understand the potential deleterious effect of food contaminants on human bodies
- develop critical thinking skills for evaluating the risks of foodborne toxicants
- learn the basic knowledge on the scientific work in the field of food safety control

Competences

At the end of the course the students will be able to:

- understand the basic concepts in food toxicology and food safety evaluation and apply these on complex issues.
- analyse problems and issues related to food contaminants and the related health outcome.
- gain the research idea on how to perform the food toxicology-related research.

EXAMINATION

Each student must submit a 2-page essay during the course and perform a 15-minute oral presentation in class. During the oral presentation, the student will present a synopsis and perspectives of the essay and be asked questions. The questions will take a starting point in the essay and be broadened out to also cover general topics from the curriculum. Via the essay and the oral presentation, the student must demonstrate an understanding of the learning objectives of the course. At the end of the course, it will be assessed, on a pass/non-pass basis, if the student performed satisfactorily.

The purpose of the essay and presentation is to assess the students' ability to:

- use the basic knowledge on food toxicology to deal with the real problems related with food safety.
- develop research idea on exploring emerging problems in food toxicology.

RE-EXAMINATION

Students who fail to pass the course can take the re-exam. Re-examination contains a 5-page written essay on a fixed topic plus a 15-minute oral presentation. During the oral presentation, the student will present a synopsis and perspectives of the assignment and be asked questions. The questions will take a starting point in the assignment and be broadened out to also cover general topics from the curriculum, to check if the student demonstrates an understanding of the learning objectives of the course.

GRADING

Evaluation is based on both written and oral presentation and is to be graded on a passed/not passed basis.

Chemical Food Safety and Health

3.75 ECTS

Course responsible coordinator: Dr. Aiqian Zhang, Professor, Research Center for Eco-Environmental Sciences, Chinese Academy of Sciences, aqzhang@rcees.ac.cn

COURSE CONTENT

This course aims to provide a broad foundation of knowledge and overview of the chemical risk in food and food safety assessment of chemicals. Preventing food contamination with various chemicals requires an understanding on how they can enter and pass along the food production and processing chain, as well as relevant issues in toxicology and risk management. Chemical Food Safety & Health offers understanding of different aspects of chemical risks in food products, provides current knowledge on the possible chemical contamination pathways during food production processes, introduces risk assessment concept and related methodologies, illustrates various kinds of chemical contamination in food and their potential health hazards, and reviews the related worldwide regulations as well. Moreover, case studies will also be included to facilitate the understanding of the current situation in chemical food safety and help in identifying the research gaps needed to be filled in.

The course includes 4 modules. Module I is the introduction to chemical food safety & health. Module II focuses on safety assessment methods for chemicals in food, covering the related topics as exposure and chemical cocktail in food, toxicity testing assays, population study and epidemiology, and computational methods as well. Module III briefly illustrates the typical types of unwanted chemical substance in food, such as naturally inherent plant toxicant and mycotoxins, metals, metalloids and other elements, pesticides, veterinary drugs, food additives and flavorings, and food allergies. Module IV is about guidelines and regulations for chemical food safety control and case study

LEARNING OUTCOMES

Knowledge

At the end of the course the students will have gained the knowledge of:

- the concept of risk assessment and safety assessment.
- safety assessment methods for chemicals.
- typical categories of chemical contaminants in food.
- chemical contamination sources and pathways for food products.
- the potential risk of chemicals in food to the human health.
- guidelines and regulations for chemical food safety control.

Skills

The student will be able to:

- point to suitable methodologies utilized to evaluate the risk of chemical contaminants of food products.
- demonstrate the chemical risks in food at the basic level, incl. typical sources, contamination pathways, and health hazards.
- understand current regulations of toxic chemicals in food for safety control.

Competences

Through the course the student is expected to gain the competencies as follows:

- high-level understanding and interpretative capacity in the sources, contamination pathways of chemicals to food and their potential risk to the health of human beings.
- critical thinking skills in the risk assessment methodology and current regulations of toxic chemicals in food to ensure the health of human beings.

EXAMINATION

The student must submit a 2500-word assignment during the course + perform an oral presentation. The presentation is a 10-minute oral presentation made in class for each student. During the oral presentation, the student will present a synopsis and perspectives of the assignment and be asked questions. The questions will take a starting point in the assignment and be broadened out to also cover general topics from the curriculum. Via the assignment and the oral presentation, the student must demonstrate an understanding of the learning objectives of the course. At the end of the course, it will be assessed, on a pass/non-pass basis, if the student performed satisfactorily.

RE-EXAMINATION

Students who fail can take the re-exam. Re-examination contains a 2500-word written assignment on a fixed topic plus a 10-minute oral presentation During the oral presentation, the student will present a synopsis and perspectives of the assignment and be asked questions. The questions will take a starting point in the assignment and be broadened out to also cover general topics from the curriculum, to check if the student demonstrate an understanding of the learning objectives of the course.

GRADING

Passed/not passed.

Food Nutrition and Health

7.5 ECTS

Course responsible coordinator: Nanna Roos, Department of Nutrition, Exercise and Sports (NEXS), University of Copenhagen, Denmark. e-mail: nro@nexs.ku.dk

COURSE CONTENT

The course covers the following thematic domains: 1. Nutrition physiology, 2. Nutritional quality of foods and diets, 3. Sustainable and healthy diets to meet nutritional requirements, and 4. Food and diets to meet requirements of specific population groups. 'Nutrition physiology' covers the introduction to basic human nutrition including energy, macro- and micronutrients, definitions, classifications, chemical structure, physical and chemical characteristics and physiological function. The basic physiological principles for digestion, absorption, transport and storage of nutrients and bioactive components in the human body is covered. 'Nutritional quality of foods and diets' covers the health implications and pathways of changing diets in populations. The pathways cover food-based dietary approaches to changing individual nutrient intakes, such as plant- vs animal-source foods; and public health approached such as mandatory and optional food fortification. 'Sustainable and healthy diets to meet nutritional requirements' covers the principles for setting nutritional requirements for different age and sex groups; an overview of international and national nutritional recommendations; the introduction to principles of setting food-based dietary guidelines; and an overview of the emergence of models for analyzing and understanding the sustainability of healthy diets. 'Food and diets to meet requirements of specific population groups' covers the introduction to methods to assess nutrition status (anthropometric measures, growth references, biochemical indicators) and public health aspects of over- and undernutrition, with specific focus on children and elderly.

LEARNING OUTCOMES

Knowledge

During the course, the student will gain knowledge in and understanding of:

- the role of nutrients (energy, macro-and micronutrients) for physiological functions in humans at different life stages
- the relations between nutrients, food, diets and health from a public health perspective
- the recent frameworks and methodologies for establishing the sustainability of diets in relation to human health
- the strength and validity of evidence of impacts of foods and diets on human health
- the principles of setting nutritional requirements, recommendations and dietary guidelines
- nutritional status assessment indicators

Skills

The student is able to:

- demonstrate skills at a basic level related to the understanding of the general principles of the characteristics of micro- and macronutrients and human nutrition physiology
- point to suitable methodologies utilized to assess and analyze diets for nutritional contribution in relation to human requirements and health
- utilize a software-based tool to analyze diets for nutritional composition and contribution to human requirements
- identify the relevance of different frameworks for sustainability of food systems and diets

- identify pathways for optimizing and improving the contributions of nutrients to from various types of diets in the view of individual preferences, public health and sustainable food production.
- skills in oral and written presentation of evidence for nutrition and health aspects of foods and diets

Competences

- work independently as well as in groups in relation to trans-cultural and interdisciplinary projects related to food, diets and health
- critically review scientific literature related to human nutrition and health
- understand and reflect on the evidence of nutritional and health impacts of food and diets
- have a basic knowledge and a critical scientific approach to understanding the evolving of frameworks for sustainable and healthy diets

EXAMINATION

The student must submit a project report made in groups of 3-4 students to qualify for an oral exam. The report must be submitted at a deadline set prior to the final exam. The length of the report is maximum 10 pages, plus illustrations and references. The topic of the project report is selected from a list of predefined topics and must follow a provided guideline for the outline.

After submission, each student will individually attend an oral exam. The total time allocated for the oral examination is 20 minutes. The student is examined for 15 minutes followed by 5 minutes for grading. The 15 minutes of examining the student is structured so the student first speak on aspects of the project report of the student's own choice, followed by questioning related to the project report and questions to the general course curriculum. The final grade will be based on the oral performance.

RE-EXAMINATION

In case of re-examination, an individual report must be submitted prior to the re-exam. The report will be minimum 5 pages on a topic decided by the course coordinator and informed to the student at least a week prior to the re-exam. The structure of the oral re-examination is the same as for the ordinary exam. The final grade will be based on the oral performance. Digital oral examination is allowed.

GRADING

Grades are given according to the Danish 7 step and the Chinese 100 points grading scales.

Food Chain Management

5 ECTS

Course responsible coordinator: Professor Jørgen Dejgård Jensen, jorgen@ifro.ku.dk and Professor ZHU Xiaoyan

COURSE CONTENT

The aim of the course is to teach the fundamentals of economics in relation to the food supply chain, and thereby give the students an understanding of producers', suppliers' and customers' behaviours and economic incentives in relation to decision making in the food supply chain.

The course will address basic principles of microeconomic theory, the laws of supply and demand and their theoretical foundation, the roles of imperfect competition (such as monopoly, monopsony, oligopoly or monopolistic competition), economic risk and incentives, and information problems (imperfect or asymmetric information) on economic decision making in product or input markets for management of the food supply chain.

Particular focus in the course will be on management of food quality, food safety and sustainability in a supply chain perspective, with active use of economic theory in relevant empirical cases from the Chinese, European and international domains. This involves the role of market structure, risk and information on food supply chain decision makers' economic incentives vis-a-vis quality, safety and sustainability.

The module consists of seven main components:

1. Economic theory of production, economies of scale, economies of scope
2. Imperfect competition,
3. Product quality and product differentiation
4. Management of economic risk (price risks, macroeconomic risks, risk of technical defaults…)
5. Management of food quality, food safety and sustainability in the food supply chain
6. Economic coordination in the food supply chain, contracts, economic incentives and asymmetric information (principal-agent relations, adverse selection, moral hazard)
7. The demand side of food markets (consumers, business-to-business, international trade)

LEARNING OUTCOMES

The main learning of the course is to make the students familiar with the concepts of economic thinking in food production, food trade, and management of food quality and safety throughout the supply chain.

After completing the course, the students should be able to:

Knowledge:

- describe the economic principles for firms' economic incentives in terms of the economic optimization of firms' output level and input use in production.
- describe the influence of the market competition environment on the economic optimization of firms' output and input use.
- reflect upon the influence of market competition environment on the economic decisions of companies' suppliers and customers.
- reflect upon the roles of risk, uncertainty and information for firms' economic incentives.

Skills:

- apply economic theory to understand market phenomena
- Be able to communicate and discuss concrete economic problems and solutions with different target groups.

Competences:

- cooperate with fellow students in analysing and solving different economic problems in a food quality and food safety perspective.
- independently work with economic problems related to the food market.

EXAMINATION

Written 4-hour presence exam. At the written exam students will for example be asked to explain economic terms, principles and mechanisms, as well as conduct and analyse economic calculations.

Aids: calculator

RE-EXAMINATION

Same format as ordinary exam

Aids: calculator

GRADING

Grades are given according to the Danish 7 step and the Chinese 100 points grading scales.

Food and Society

5 ECTS

Course responsible coordinator: Wesley Dean, wesleydean@ifro.ku.dk.

COURSE CONTENT

The course introduces students to key aspects of social scientific analysis of food systems and to social science perspectives on food and health. The course will start with a short introduction to the history of the global, the Western and the Chinese food systems. Hereafter, the course will make an introduction to key actors in the Danish and Chinese food systems and how responsibility for food related health, safety and quality is distributed between actors in the two systems. Key concepts and understandings of risk and sustainability will be introduced and analyzed in relation to mainstream and alternative food systems. Further, the course introduces students to the different understandings of and perspectives on food quality, safety and health among actors in the food system, such as consumers, producers, manufacturers, retailers, experts and public authorities. Differences and contrasts between lay and expert perspectives on safety and health will be highlighted, as an avenue to understand the social construction of risk.

LEARNING OUTCOMES

Knowledge

During the course, the student will gain knowledge in and understanding of:

- historical development of global and local food systems.
- differences between food systems in Eastern and Western parts of the world (China & Denmark).
- interests, strategies and concerns of actors in the food sector.
- the significance of social contexts and societal framings of issues.
- the governance of health, safety, and quality, in relation to food.
- lay people's practices and concerns in relation to food.
- sociological concepts and theory related to food, health, and quality.

Skills

The students will be able to:

- demonstrate skills at basic level to analyse food systems.
- identify different perspectives on central issues in the food system.
- analyse differences in interests, strategies and concerns among food system actors.
- use sociological concepts to describe key issues in the food system.
- demonstrate understanding of and ability to use key sociological concepts related to the food area.

Competences

At the end of the course the student will be able to:

- understand complexity of societal issues related to food.
- analyse problems and issues related to food and health in a societal perspective.

- critically review existing policies and strategies related to food.
- map differences in interests and concerns related to challenges in the food system.
- use relevant sociological concepts and theory to understand food issues.

EXAMINATION

The final exam is an individual 24-hours written exam. The students will be presented to 2-3 problems related to the food sector. They are expected to choose one problem and write a short analysis of central social aspects of it (maximum 2000 words). In this, they should identify and use material from relevant sources, and draw on the course curriculum.

The purpose of the examination is to assess the students' ability to:

- integrate knowledge of food systems, food system actors' interests, different understandings of key issues in relation to food and health, in the analysis of a specific problem.
- utilize the above-mentioned knowledge in a coherent understanding of the complexities of the food system.

RE-EXAMINATION

The re-examination will have the same format as the ordinary exam.

GRADING

Grades are given according to the Danish 7 step and the Chinese 100 points grading scales.

Food Business, Marketing and the Consumer

5 ECTS

Course responsible coordinator: Prof. Klaus G. Grunert, klg@mgmt.au.dk and Prof. Hong Zhao, zhaohong@ucas.edu.cn

COURSE CONTENT

This module aims to provide students with a general view of business, marketing, consumer, and social issues in the food industry. It first introduces the students to the fundamentals of the food industry and food consumers. This module then familiarizes the students with key marketing decisions in the food business. Finally, it offers the students a social perspective on food business.

The content of this module includes four parts:

- Part 1 offers an introduction to food business in terms of food business environment, economics of food production and food marketing.
- Part 2 explores food consumers with a focus on consumer decisions when buying food, as well as the research tools used to understand food consumers.
- Part 3 is centred on food marketing decisions, starting with marketing strategy, and dealing then with marketing mix, branding, marketing communication, pricing and food distribution.
- Part 4 covers several social issues in food marketing, such as health, sustainability, ethical marketing behaviour, and social responsibility of food companies.

LEARNING OUTCOMES

Knowledge

After this module, students should have knowledge on basic concepts of food marketing, notably:

- on the major constraints that a food business has to operate in.
- on the way consumers make decisions when buying food, and what these decisions mean for the food business.
- on basic concepts and theoretical tools useful for planning and executing business on food markets, both at the strategic an operational level
- on the major societal issues facing the food sector today

Skills

After this module, students should have acquired the following skills:

- analyse the market conditions for a food company, both in terms of external and internal factors.
- develop an in-depth understanding of what drives the behaviour of food consumers.
- develop marketing strategies and plan and monitor their implementation.
- analyse possible combinations of marketing parameters and combine them into a marketing plan.

Competences

The student will, through the module, acquire the competencies that enable her/him to work in an outward-directed function in a food company, like marketing manager, brand manager, public relations officer, regulatory affairs officer.

EXAMINATION

The students need to submit an individual written assignment during the course to qualify for the exam. The assignment will involve describing the environment of a chosen food company and develop a marketing plan, 5-6 pages (completing this will also qualify the student for the re-exam). The report will be evaluated on a pass/ not-passed basis. In the case that a report is not passed, the report needs to be edited for the students to get a pass, so they can attend the final exam. The report does not form a part of the final grade but qualify the students for the final exam.

The final examination is 3 hours, open book (internet is not allowed).

RE-EXAMINATION

Students who do not get a pass for the report in due time for the ordinary exam or does not pass the written exam, can take the re-exam in the part(s) not passed. The re-exam will follow the same format as the ordinary exam.

GRADING

Grades are given according to the Danish 7 step and the Chinese 100 points grading scales.

Life Science Engineering and Informatics

Molecular genetics and epigenetics

5 ECTS

CONTENT
The course will provide the students with the skills to understand and explain the basic molecular architectures of plant and animal genomes as well as the basic mechanisms that regulate genome functions. Furthermore, the course will provide the students with the ability to understand and discuss principles of molecular genetics including an insight into and the use of methods to identify complex traits and disease genes.

- The organisation of plant and animal genomes.
- Identification and characterization of DNA sequences, genes and molecular genetic variation.
- Molecular methods used to map Mendelian and complex traits.
- Basic mechanisms in genetic regulation of genome function.
- Basic mechanisms underlying epigenetic phenomena, including DNA methylation, chromatin modification, RNA methylation and noncoding RNA.
- Reading, understanding and oral presentations of scientific papers.

The teachings are scheduled continuously over eight weeks with two to four sessions per week. The teaching comprises lectures, discussion, student presentations and exercises.

LEARNING OBJECTIVES
By the end of the course, the student is expected to have the skills to:

- explain the architecture of plant and animal genomes.
- discuss the mechanisms that regulate the functions of the genome.
- discuss the principles of molecular genetic methods and the techniques used to identify complex traits and disease genes.
- explain principles and mechanisms underlying epigenetic phenomena.
- critically read, understand, and orally present scientific papers.

EXAMINATION
At the end of the course, the students will be assigned a written assignment consisting of a written report to answer individual assignments. The students will have 1 week to hand in the report. The requirements of the students written replies to the assignment are minimum 6 pages maximum 7 pages including 1 page with table/figure and legend and 1 page with references. The requirements for the remaining 5 pages of the report are: these 5 pages should include an abstract/summary, Genetics, Phenotype description, Methods/analysis approach if appropriate. All pages should have 2 cm margins, font size 11, line separation 1.5

RE-EXAMINATION
Re-exam will follow the same format.
GRADING
Grades are given according to the Danish 7 step and the Chinese 100 points grading scales.

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Central techniques in Omics

9 ECTS

CONTENT
Biosciences in the post genome era are a technology driven field. Progress depends on investigating molecular changes with large-scale technologies. This course aims to build basic understanding of the technologies and methods used to characterise and detect variations in genome, transcriptome, proteome, and metabolites of humans, animals, plants and microorganisms, and to provide students with knowledge sufficient for evaluating the specific strengths, weaknesses and possibilities of individual basic methods for characterising biological systems at molecular levels.
The course will provide the students with skills to understand, explain and select the relevant basic methods for characterising biological systems by large-scale molecular mapping methods. The students will develop the skills to evaluate the strengths and shortcomings of specific technological approaches currently available for describing genome, proteome, transcriptome and metabolome changes in biological systems. The competences achieved are appropriate for preparing the students for designing their own experimental approaches for their final master projects.

Content and perspective:

- Mass spectrometry technology (Instrumentation, Electrospray ionization, Maldi-TOF, ion optics, mass analysers and operation).
- Practical introduction to Protein id and characterization in Proteomics and Metabolomics. Interpretation of data including post-translational modifications.
- Protein and metabolite quantification (LC-MS/MS, SRM and MRM methods).
- Array technology applied in omics.
- Advanced Imaging in omics (EM, MALDI Imaging).
- NMR based metabolomics.
- Next generation DNA sequencing.
- RNAseq based transcriptomics.
- MicroRNA technology.

LEARNING OBJECTIVES
The student who has met the objectives of the course will be able to:

- evaluate strengths and limitations of various statistical methods.
- explain the overall theoretical principles behind the statistical methods introduced during the course.
- account for the preconditions, assumptions and limitations in the individual steps of the statistical analysis.
- independently perform a basic analysis of the various omics data using R.

By the end of the course, the student is expected to have the skills to be able to:

- evaluate strengths and limitations of individual central technologies for structural and quantitative analyses of DNA, mRNA, proteins and metabolites from biological samples.
- evaluate the quality of data from proteome, genome, transcriptome and metabolome analyses as presented in original scientific literature.
- evaluate and reflect on the shortcomings of the specific methods and technologies chosen to describe specific biological systems in original research articles.
- suggest alternative approaches to those presented in original scientific literature.
- motivate the choice of experimental methods and approaches for describing and investigating specific biological problems.

Learning outcome from the theoretical part:
Being able to read, understand, explain, and to evaluate critically the methods and information from primary research articles using the following omics methods:

- protein identification by Maldi-TOF based peptide mass fingerprinting.
- protein id by ESI-MS/MS.
- metabolite id and quantification analyses by Mass spectrometry.
- protein quantification by Mass spectrometry.
- discovery based comparative proteome mapping.
- hypothesis based (targeted) comparative proteome mapping.
- Selected reaction monitoring MS. (SRM).
- proteogenomic data integration.
- mapping of posttranslational modification of proteins.

- microarray based transcriptome mapping.
- next-generation based transcriptome mapping.
- genome sequencing

Learning outcome from the laboratory part:
Being able to plan experiments, interpret raw data, critically evaluate data quality and to integrate data across the following omics technologies:

- protein identification by Maldi-TOF based peptide mass fingerprinting.
- protein id by ESI-MS/MS.
- protein quantification by Mass spectrometry.
- discovery based comparative proteome mapping.
- hypothesis based (Targeted) comparative proteome mapping.
- selected reaction monitoring MS (SRM).
- mapping raw instrument data against reference genome data.
- microarray based transcriptome mapping.
- next-gen based transcriptome mapping.

EXAMINATION
One exam consisting of an individual written assignment that includes short answer, computational, and essay questions. The assignment is a maximum of 5 pages (font size approx. 11, normal margins), and is to be completed in 48 hours.

RE-EXAMINATION
Same as the ordinary exam.

GRADING
Grades are given according to the Danish 7 step and the Chinese 100 points grading scales.

Bioinformatics and Systems Biology

7 ECTS

CONTENT

Bioinformatics is today essential for almost all branches of life sciences, as data generation has become more accessible globally. For instance, the advent of Next Generation Sequencing (NGS) technologies has transformed how biological research is being performed and today almost all biological fields use the technology for innovative discoveries. Whole human genomes can today be sequenced cost effectively and rapidly providing unprecedented possibilities for investigating human traits, evolution and diseases. Similarly, whole bacterial communities and their interplay with the environment can be studied, unravelling novel enzymes and organisms. As these experiments produce massive amounts of data, skills with bioinformatics and large data supercomputing are crucial for analysis. The aim of the course is to give the students a good knowledge of the NGS technology and steps for sequence data analysis as well as a background to bioinformatics in general and an introduction to biological data science.

The course content is structured in 4 main modules, described hereafter.

Module 1 - Introduction to bioinformatics

The lectures introduce the students to the basics of bioinformatics including the electronic data formats for storing information about biological macromolecules, such as DNA, RNA and proteins, as well introduce them to publicly available sequence and structure databases such as GenBank, UniProt and PDB. The section will provide students with knowledge of several new methods for molecular structure and sequence analysis. Second half of each lecture day includes hands-on sessions of computer exercises, where the methods are learned through practical use. Module assessment: Based on the completion of the daily exercises, which include searching data, running different tools and based on the results replying to the questions included in the exercises. These exercises are to be completed in the class or at home.

Module 2 – Introduction to NGS

The aim of this module is to give a solid knowledge of NGS and NGS data processing and the relevant corresponding tools. Students should be able to understand and apply this information to practical uses, such as screening large segments of sequenced DNA extracted from wide-ranging clinical or environmental samples.

Module 3 – Biological Data Science

This module presents the main computational tools to load, analyze, visualize, and model biological data. It will present methods as PCA, linear and logistic regression, clustering, and basic Machine Learning, all applied to biological datasets.

Module 4 – Applied Bioinformatics

In this module, the students will work on cases studies where Bioinformatics and Biological Data Science are used to solve relevant scientific problems involving biological and clinical data.

LEARNING OBJECTIVES

A student who has met the objectives of the course will be able to:

- demonstrate insight in structured problem solving.
- break down real-world data problems.
- recognise patterns in data and generalize from them.
- search for sequence and structure data from the publicly available databases, such as GenBank, UniProt and PDB.
- generate and critically evaluate DNA and peptide alignments.

- query sequence databases using alignment-based methods (BLAST) and critically evaluate the results.
- explain basic concepts of machine learning and data science.
- parse (read and extract) (bioinformatics data) files for needed information. Understand and operate with common formats for representing DNA and protein sequence data.
- explain the applications of the different NGS technologies, including the weakness and strengths of the approaches, learn to implement the steps involved in a general NGS data analysis.
- cooperate in groups and communicate results.

EXAMINATION

The exam is a 24-hour assignment with an oral defense. The assignment will cover the entire course and must be between 5 and 10 pages, including exercises and theoretical questions. The oral defense will amount of up to 30 minutes including questioning and grading. For the oral defense, the student will go through their assignment and there will be general questions about the course content.

GRADING

A single grade will be assigned, derived from the written assignment (50% weight) and oral exam (50% weight), given according to the Danish 7 step and the Chinese 100 points grading scales.

RE-EXAMINATION

An oral re-examination of 30 minutes covering the whole course.

Biostatistics

3 ECTS

CONTENT

Sophisticated statistical methods for analysing omics data are increasingly employed to deal with the complex data sets from the high-throughput experiments. With statistical tools, scientists generate testable hypotheses and draw the scientific conclusions supported by data. This course aims to build a basic understanding of the theoretical and practical aspects of various biostatistical concepts and analytical methods commonly used in the omics field. It focuses on the concepts of experimental design, qualitative and quantitative analysis of data, and statistical inferences. The course also aims to provide the students with knowledge sufficient for evaluating the specific strengths, weaknesses and possibilities of individual statistical methods as well as the capability to read articles on the subject critically. In addition, this course will provide a hands-on tutorial on analysing data with R, the most important statistical tool in the academy.

Content and perspective

- Descriptive statistics
- Introduction to probability
- Introduction to hypothesis testing (for two groups of numbers)
- Introduction to multiple hypothesis testing
- Introduction to analysis of variance (ANOVA)
- 2 by 2 contingency table
- Linear regression
- Correlation
- Principal component analysis (PCA) and cluster analysis
- Statistical power
- Data transformation
- Data visualisation

LEARNING OBJECTIVES

Knowledge

The student who has met the objectives of the course will be able to:

- explain the overall theoretical principles behind the statistical methods introduced in the course.
- evaluate strengths and limitations of various statistical methods.
- account for the preconditions, assumptions and limitations in the individual steps of the statistical analysis.
- apply reasonable statistical methods in analysing empirical data.
- independently perform a basic analysis of the various omics data using R.

Skills

By the end of the course, the student is expected to have the skills to:

- explain the basic principles underlying statistical methods.
- evaluate strengths and limitations of various statistical methods for data analysis.

- use R language to perform statistical tests.

EXAMINATION

Final exam are two reports based on the use of statistics in 2 hypothetical research projects. The grade of each report will count as 50 % of the final grade. The student describes how they solve a given biostatistics assignment in two omics areas. Details on the individual assignments will be discussed during the exercises. Each report should consist of between 3 pages and 5 pages (excluding references). A report must contain the following sections: a) introduction and description of assignment; b) overview of the student's procedure to solve the task; and c) evaluation of results and conclusion."

RE-EXAMINATION

The Re-examination will have the same format as the ordinary exam, but a new topic must be chosen.

GRADING

Grades are given according to the Danish 7 step and the Chinese 100 points grading scales.

Applied Omics in Food and Veterinary Sciences

5 ECTS

COURSE COORDINATOR TEAM

Denmark: Birte Svensson, Professor, bis@bio.dtu.dk, DTU Bioengineering, Department of Biotechnology and Biomedicine, Technical University of Denmark. DTU Bioengineering, René Lametsch, Associate Professor, rla@food.ku.dk, Department of Food Science, University of Copenhagen. Ulrich auf dem Keller, Professor, uadk@dtu.dk, DTU Bioengineering, Department of Biotechnology and Biomedicine, Technical University of Denmark.

The "omics" disciplines are strongly in demand in the sectors of food, biomedicine, biotechnology, agriculture, and applied microbiology. In these areas, "omics" represent an underexploited potential of technologies with great promise to advance developments to gain insights at the molecular level into e.g. quality of foods, feed and raw materials, human and animal disease mechanisms, probiotics, processes in food and ingredients production, nutritional values, crop plant breeding, biotechnology and fermentation. The use of "omics" techniques is rapidly implemented in these fields of applied research with anticipated huge benefits including the development of dedicated emerging "omics" tools and insights.

The course aims to provide a broad knowledge of the use of "omics" in food science, biomedicine and health, probiotic and commensal gut bacteria, meat and dairy products, cereals and vegetables. It will provide background into the technical sub-disciplines of proteomics with reported application in areas of food and health sciences. Case stories will be selected to cover various thematics including functional properties of key proteins involved *e.g.* i) uptake and metabolism of prebiotic oligosaccharides by probiotic and commensal bacteria in the human gut, ii) quality of selected foods in particular meat, dairy and plant based products and iii) protease degradomics in health and disease. The course focuses on familiarizing with the topics and experimental design from sample preparation to qualitative and quantitative analysis of data. It aims to provide the students with knowledge sufficient for formulating hypotheses and proposing research strategies to pursue objectives within different areas of applied food, biomedicine and agricultural sciences and to evaluate specific strengths, weaknesses and possibilities for individual experimental plans and projects as well as the competence to critically read recent scientific literature on relevant topics.

LEARNING OBJECTIVE

The student who has met the objectives of the course will be able to:

- evaluate strengths and limitations of selected relevant experimental plans in the area of food and agricultural proteomics.
- explain the possibility of integration of various "omics" techniques for individual detailed and comprehensive qualitative and quantitative characterization of normal and disease states in humans, animals and crop plants.
- account for the preconditions to provide experimental design to achieve given objectives.
- independently present a critical account of the application of "omics" in a selected theme within food, biomedicine and agricultural sciences.

CONTENT AND PERSPECTIVE

1. Lectures on brush-up proteomics and relevant special techniques in proteomics
2. Introduction to the areas of food, biomedicine, biotechnology and agricultural sciences
3. Description of case stories on "omics" in probiotic and commensal gut bacteria
4. Description of case stories on "omics" in meat, dairy, cereal crops, vegetables and other food raw materials for functional properties and quality
5. Description of case stories relevant for key roles of proteases in health and disease
6. Description of case stories in stem cell technologies, clinical research, and biomarker discovery
7. Highlighting the strategy from omics-based discovery of key proteins to characterization of their structure and function
8. Future perspectives on application of "omics" in life, food and environmental sciences

LITERATURE

Original articles and thematic reviews.

EXAMINIATION

The exam is based on two reports. One report is an individual short topical essay (3 pages) handed in on the last teaching day of the course of which the topic is based on one of 5 scientific articles, handed out 5 days before the last teaching day of the course. The other report is a project report (15-30 pages) made by a team of 3-4 students on a chosen subject (one out of 6) within the course content, with a deadline the third last teaching day of the course. Each report accounts for 50% of the final grade.

RE-EXAMINATION

3 hour written exam in the form of a short essay addressing a theme given by a paper handed out at the exam and which is within a topic covered in the course. All aids are permitted.

GRADING

Grades are given according to the Danish 7 step and the Chinese 100 points grading scales.

Nanoscience & Technology

Nanoelectronics

5 ECTS

Course responsible: Kasper Grove-Rasmussen k_grove@nbi.ku.dk

CONTENT

The course will cover the following areas: concepts in electron transport, current flow in nanostructures, mesoscopic electron transport, the quantisation of charge, and conductance and their consequences for transport, Landauer (transmission) formalism. The chosen examples will include quantum wires, low dimensional semiconductor structures, quantum dots, graphene, carbon nanotubes, molecular transistors, and other timely subjects in nanoelectronics. One session will be devoted to nanofabrication.

The course also includes two laboratory experiments:

- Measurement of the Quantum Hall effect and Shubnikov de Haas oscillations in a two-dimensional electron gas at low temperatures (4 Kelvin).
- Fabrication or measurements of quantum dots.

The experimental results are to be analysed in context of the theory presented in the course and summarised in reports written in groups of 3-4 students.

We aim at giving a phenomenological introduction to selected topics in the physics of nanostructures. The general theme is current flow (electron transport) in (low-dimensional) nanoscale structures, where quantum effects are expressed clearly. The basic formalism, key concepts and real experiments will be discussed, rather than complete theoretical treatments, which are covered in other courses. The students will be provided with the background for understanding a wealth of recent experiments in the field which ranges from quantum Hall physics, single-electron transport through "artificial atoms" in semiconductor structures to real "molecular transistors" based on single molecules. In addition to the purely scientific interest, these phenomena are also of technological importance in nanoelectronics and potential future applications in quantum information processing.

LEARNING OBJECTIVES

Knowledge

After completing the course, the students should be able to

- describe the differences between transport in bulk materials (metals, semiconductors) and nanostructures, i.e. transport in different dimensions.
- describe the functionality of selected nanoelectronic devices based on these principles.
- describe fabrication methods and materials used for making nanodevices.
- describe and sketch the key elements in realising an electron transport experiment on a nanostructure.
- explain the most prominent consequences of quantum effects in electron transport through nanostructures (limited to the contents of the course).
- explain the differences between ideal theoretical quantum phenomena and measurements under less ideal conditions
- know basic low-temperature techniques for measuring of nanodevices.

Skills

- apply the acquired knowledge to analyse experimental data and extract relevant parameters, e.g., the essential length scales, energy scales, characteristic temperatures, quantized units etc.
- carry out experiments on simple experimental setups for measurements of nanodevices.

Competencies

- analyse experimental data and write a report presenting relevant theory, experimental results and analysis.
- demonstrate understanding of the basic formalism and the key concepts within electron transport.
- read and understand relevant scientific literature on electron transport in nanodevices.

EXAMINATION

Oral examination, no preparation time (25 min + 5 min not including deliberation), 10-12 minutes presentation based on one of the experiments A or B (or other relevant topics if announced) followed by a discussion on material covered in the course.

RE-EXAMINATION

The same as the ordinary exam. The re-exam will be held as the ordinary exam, experiment (A or B) must be completed before re-exam.

GRADING

Grades are given according to the Danish 7 step and the Chinese 100 points grading scales.

Synthesis and Fabrication

10 ECTS

Course responsible: Zhongming Wei, zmwei@semi.ac.cn

CONTENT

The course will be taught based on recent reviews on the state-of-the-art nano-assembly and top-down/bottom-up nanofabrication. The student will learn different chemical methods used in construction of functional molecules and in surface and polymer modification as well as lithographic procedures for nanofabrication.

Throughout the course, the students will learn the fundamental synthesise method, characterization, properties and device applications for nano materials including self-assembled monolayers, organic semiconductors, grapheme and grapheme oxide, nanoporous and polymers. The study will help the students to understand the frontiers of functional nanomaterials.

LEARNING OBJECTIVES

Knowledge

Nanomaterials are fabricated by utilising modern chemistry design, technology and techniques. The student will be made familiar with these synthetical techniques, chemical/physical methods to characterize the nanomaterials and enable their applications.

A student that fully meets the requirements of the course should be able to:

- Fabrication of self-assembled monolayers
- Single-molecule devices
- Organic electronics: OLED, OFET, OSC
- Novel nanoporous materials
- Graphene, Chemical GO
- Graphene, CVD, properties, characterization, application in devices
- Polymer

Skills

The student will get skills of the synthesis methods, analysis and utilizations (especially the device applications) for functional organic nanomaterials and apply the above knowledge for evaluating and calculating functional nanomaterials.

Competencies

The student will get the abilities of understanding frontiers of functional nanomaterials, the systematically training for the nanomaterials related synthesis and fabrication processes, write and evaluate specific literatures, techniques, and design a research proposal for functional nanomaterial.

EXAMINATION

Oral exam (80%) and assignments (20%). To qualify for the oral exam, students must hand in 2 assignments. The assignments will be reference article reading and written reports.

The oral exam is 30 minutes, no aids, no preparation time.

RE-EXAMINATION

Re-exam same as ordinary. Assignments must be completed before the re-exam. Passed exams will be transferred to the re-exam.

GRADING

Grades are given according to the Danish 7 step and the Chinese 100 points grading scales. Internal censorship.

Bionanomaterials

5 ECTS

Course responsible: Baoquan Ding, dingbq@nanoctr.cn

CONTENT

The aim of this course is to provide the students with background knowledge on bionanomaterials based on the assembly of nucleic acid, peptide, and protein. To introduce the latest achievements in basic research and potential applications.

This course will go through themes such as: Self-assembly of biological molecules. Design and assembly principle of DNA and RNA nanostructures: build 3D nanostructures with controlled size and geometry. DNA based organic synthesis. Modification of nucleic acids nanostructures with various functional elements. Nucleic acids-based imaging probes and drug delivery system. Artificial molecular devices. Construction of peptide assembly nanostructures. Protein assembly nanostructures. Peptide assembly-based nanomaterials. Biomedical application of peptide-based nanomaterials. Disease associated peptide and protein assembly.

LEARNING OBJECTIVES

Knowledge: Molecular structures of natural and artificial nucleic acids and peptides; strategies to assemble these molecules into nanomaterials with different functions.

Skills: Designing of nanostructures using biomolecules

Competencies: The students will learn the principal of biomolecular assembly and the latest progress in the field of biomaterials, drug delivery, etc. They will gain higher innovation consciousness on biomedical studies and be ready for their own research.

At the end of the course, the students should be able to:

- describe the basic concept of DNA and RNA nanotechnology; explain and compare different strategies to assemble DNA nanostructure; design DNA nanostructures with provided software relate models of designed nanostructures to fabrication of nucleic acids nanomaterials; explain the strategies to assemble metal nanoparticle for plasmonic study and encapsulate drug molecules for therapeutic purpose.
- read and give a short presentation of a scientific paper within the subject area, understand the basic concept of peptide and protein assembly.
- understand the interaction mechanism between peptides in peptide and protein assembly; describe the possible aggregation pathways in peptide assembly; explain the strategies to design peptide assembly nanostructures for biomedical applications.
- expose the above goals in a scientifically correct language.

EXAMINATION

A three-day take-home assignment in the form of an essay. The Essay must include your analysis of the provided reference and your answers for the provided questions and the scope should be 5-8 pages. All aid allowed. All students will be evaluated based on their class attendance (25%) and the essay (75%). There will be one final grade base on the two grades.

RE-EXAMINATION

The re-examination will be graded based on a 3-day take home assignment in the form of an essay. The Essay must include your analysis of the provided reference and your answers for the provided questions and the scope should be 8-10 pages.

GRADING

Grades are given according to the Danish 7 step and the Chinese 100 points grading scales. Internal censorship.

Business Innovation and Entrepreneurship

5 ECTS

Course responsible: Yimei Hu, yimei@business.aau.dk

CONTENT

Taking into consideration that more natural sciences graduates will work in companies in real business contexts or start new business ventures as their career choices, this course will introduce main concepts and theories related to innovation, entrepreneurship, and business management.

How to organise and manage technological activities is an important part of a high-velocity global market. To keep competitive advantage in such a dynamic global market, companies and organisations are required to change and develop continuously, i.e., work with innovation. On the other hand, to take advantage of the new global and technological opportunities, new value creation opportunities can be captured and realized through entrepreneurial initiatives. For business and innovation managers, the ability to analyse the market, and ensure value creation and appropriation are hereby core to business sustainability.

The main subjects covered are:

- Concepts of innovation, entrepreneurship, and organisation
- Market structure, business strategies, and strategic management
- Culture and Organisation

The course comprises lectures, cases, discussions, guest lecturers, and students' active involvement.

LEARNING OBJECTIVES

By the end of the course, the students are expected to relate knowledge learnt from the course and nanotechnology knowledge, and gain the following knowledge, skills, and competences.

Knowledge
- basic concepts and theories in innovation, entrepreneurship, and strategic management.
- explain basic characteristics of different market structure and competitive strategies.
- describe different types of organization structures.
- explain the role of nano technologies and nano research in innovation and value creation processes.

Skills
- identify different types of organization structures and their pros and cons.
- apply the principles and theories to analyse an industry or a market.
- apply the tools and frameworks to critically analyse a business model.

Competencies
- identify a business idea based on current engineering and scientific knowledge in nano technology.
- design a business model and organization structure suitable for a business idea.
- critical thinking and comprehensive reflection on business environment.

EXAMINATION

Essay 5-10 pages based on questions from the examiner. 1 week take home.

Format:

- Min 5 pages, max 10 pages (excluding references, tables, and figures)

- Standard page, font 12, double line space.

RE-EXAMINATION

The same as the ordinary exam.

GRADING

Grades are given according to the Danish 7 step and the Chinese 100 points grading scales.

Nano Energy Materials

5 ECTS

Course responsible: Stefan Wendt swendt@inano.au.dk

CONTENT

In the course, the students will gain understanding of fundamental concepts required to understand the technological developments of nanomaterials for energy applications. This includes introduction to both theoretical background, concepts and techniques associated with the research in the field. Furthermore, examples based on recent scientific literature will be included as well as mandatory weekly assignments.

LEARNING OBJECTIVES

KNOWLEDGE

At the end of the course, the students should be able to:

- describe fundamental concepts in the synthesis, physical properties, and applications of nano energy materials.
- explain basic nucleation and growth theory as well as nanoparticle interactions.
- relate surface physics and chemistry to nanoparticle morphology.
- relate nanoparticle morphology and size to its properties.
- explain the interrelationship between band structure and properties.
- explain the fundamental concepts of the following technologies, and the role and benefits of nanomaterials: photovoltaics, catalysts, super-capacitors, batteries, hydrogen storage materials.

SKILLS

- apply the acquired knowledge about nano energy materials to critically design and evaluate specific experimental model systems.
- analyse experimental data obtained in nano energy materials systems.

COMPETENCIES

- choose and evaluate protocols and systems for specific nano energy systems.
- express both verbally and in writing the nano energy material concepts in a scientifically clear, correct and engaging language.
- design synthesis of functional nanoparticles and thereby control their size distribution.

EXAMINATION

3-hour written exam without aids. The course grade is based on the written exam (100%). Passing the mandatory weekly assignments is required to qualify for the exam.

RE- EXAMINATION

The re-examination is the same as ordinary. The weekly assignments must be passed before the re-exam. Re-examination will be converted to oral examination in case of less than five students: 30 min. oral exam, no aids, no preparation time.

GRADING

Grades are given according to the Danish 7 step and the Chinese 100 points grading scales.

Neuroscience and Neuroimaging

Magnetic Resonance Imaging

5 ECTS

CONTENT

Basic MRI covers the basic principles of magnetic resonance (MR) imaging and some research methods. This includes spin dynamics in a magnetic field, interaction of magnetization by radiofrequency pulses, principles of MR imaging using magnetic field gradients, relaxation of magnetization and contrast in images. The most important applications of MR will be introduced. These include angiography and blood flow measurement, perfusion and diffusion assessment and functional MRI. Besides, examples of the clinical use of MR imaging will be given.

LEARNING OBJECTIVES

Knowledge

The student should have knowledge of the basic principles of:

- magnetic dipole moments in a magnetic field.
- image formation.
- obtaining contrast in MR images.
- using MRI for various physiological measurements.
- clinical MRI.

Skills

- possess overall knowledge of fundamental MRI and the clinical use of MRI.
- understanding of which kind of research problems for which MR can be used.
- understanding of the limitations of MR.

Competences

- competence to be able to participate in research projects using MRI.
- competence to be able to participate in evaluation of MR scanners for equipment purchasing.

EXAMINATION

20 min oral examination without preparation, drawn from a pool of unknown topics. Examiners will be teachers from the course. 7-step grading scale/100 points. Internal censor.

RE-EXAMINATION

Will be in the same form as original exam

GRADING

Grades are given according to the Danish 7 step and the Chinese 100 points grading scales.

Methods in Preclinical Neuroscience

5 ECTS

Module coordinator team

China: Principal Investigator Ninglong Xu, Center for Excellence in Brain Science and Intelligence Technology, Institute of Neuroscience, CAS Shanghai; (xunl@ion.ac.cn)

Associate Professor Zhaolin Hua, State Key Laboratory of Brain and Cognitive Science, Institute of Biophysics, CAS Beijing, (zlhua@moon.ibp.ac.cn)

Denmark: Associate Professor Anders Olsen, Department of Chemistry and Bioscience, AAU; (ao@bio.aau.dk)

AIM

A multitude of methods and models are used in modern neuroscience to study molecular interactions, network, functions, behaviour etc. The aim of this course is to introduce various methods and models for preclinical neuroscience research, including methods of behavioural measurement, optical imaging and cell- type specific manipulations of brain activity that are central for these studies. The students will be introduced to various animal models currently used in neuroscience research. The techniques for generating novel transgenic models using genetic manipulation of popular model organisms, such as C. elegans, Drosophila, and mice will be described. A particular focus will be placed on the different types of genetic models used to study neurological disease. The usages of these models in modern neuroimaging, the selection of an appropriate animal model, and experimental design will be discussed. Finally, the students will be introduced to ethical considerations in animal experiments (i.e. the 3R's: Replacement, Reduction, Refinement) and legislative aspects pertaining to animal experiments.

LEARNING OBJECTIVES

Knowledge

At the end of the course, the students will have gained knowledge and understanding of:

- Common techniques of genome editing used to generate transgenic animals
- Techniques of how to record and manipulate brain activity using optical methods
- The strengths and limitations of the different animal models on the basis of their human physiological and pathophysiological relevance
- The problems of defining and selecting the most appropriate animal model(s)
- Knowledge of animal ethics and the 3R's and of legislative aspects of carrying out animal experiments (both independently and under supervision)

Skills

During the course the student will have obtained skills to:

- Evaluate results derived from experiments performed in animals in neuroscience research
- Identify the relevant animal model or combinations of models to address a particular neuroscientific question
- Design animal experiments that can generate statistically sound and conclusive results required for publications.

Competencies

The student is expected to gain the following competencies through the course:

- Evaluate animal models on the basis of their human physiological and pathophysiological relevance
- Select the best animal models based on the above criteria, and independently design animal experiments as part of neuroscientific studies
- Participate in improving/modifying existing animal models and develop new and better animal models to solve neuroscientific problems
- Be able to advance experimental neuroscience research by the use of modern techniques of neuroimaging and optogenetics.

Student requirements

General knowledge of the nervous system at a level equivalent to the Basic Neuroscience Course (BNS).

ASSIGNMENT AND EXAM

80% of the grade will be given on the basis of a written take-home assignment. The assignment should be submitted 5 days after being set. 5 pages long. All aids allowed.

Internal censor.

20% of the grade will be on the basis from group exercise during the course

RE-EXAM

The re-exam is a 5 day take home assignment. 5 pages long. All aids allowed.

Internal censor.

GRADING

Grades are given according to the Danish 7 step and the Chinese 100 points grading scales

Neuroscience in a Clinical Perspective

5 ECTS

CONTENT

This course builds upon the knowledge obtained in BNS with a focus on clinical perspectives of neuroscience and the methods used (e.g. EEG & other neurophysiologic methods as well as PET, autoradiography and radiochemistry). Although we may be interested in very basic questions about neuronal behavior or the optimization of MR coils, then in the end much of the research in neuroscience have implications for patients at some point. Similarly, patients have through various injuries and diseases helped neuroscientists to gain a better understanding of how the brain works, whereby, knowledge about patients also may help researchers in basic research. The goal is a broad introduction to various clinical aspects and the students will be introduced to common psychiatric disorders (e.g. affective disorders - unipolar (depression) and bipolar (manic-depressive); schizophrenia; OCD; addiction, etc.). In addition, the course also touches neurodegenerative diseases (e.g. Parkinson's and Alzheimer's diseases) and developmental disorders (e.g. Autism). In addition, students are introduced to neuropsychological issues following brain injury and how patient assessment is done and what rehabilitation and treatment perspectives are available.

Recommended student requirements

Knowledge equivalent to Basic Neuroscience, Fundamental Biomedical Signal Processing and Medical Imaging Techniques.

LEARNING OBJECTIVES

Knowledge

The course will enable the student to understand and reflect on:

- central neuroscience topics related to both normal brain function and neuropsychiatric disorders.
- how neuroanatomy and transmission affect mental functions.
- basic features and applications of several important methodologies in clinical neuroscience such as assessment, symptoms, treatment, including general neuroscience methods.

Skills

During the course, the student will acquire skills in:

- basic insights into examination and assessment.
- the molecular basis of mental function in health and disease with particular focus on serotonergic, noradrenergic, and dopaminergic mechanisms.
- the behavioral disturbances affected by these neurotransmitters e.g. in neurodegenerative, psychiatric, and neuropsychological disorders from a biopsychosocial perspective.
- identifying treatment perspectives of the described disorders.

Competences

At the end of the course the student will be able to:

- select and certify the most suitable methodologies for studying neurological, psychiatric, and neuropsychological disorders.
- reflect on the cause of behavioural disturbances and propose research solutions.
- have a basic foundation to critically review scientific publications dealing with neurological, psychiatric, and neuropsychological diseases.

- combine molecular, anatomical and signalling knowledge to gain insight and suggest research approaches in the study of diseases of the brain.

EXAMINATION

The exam is a 2-hour written multiple-choice examination without aids. For each question, it will be indicated how it contributes to the grade. Internal censor.

RE-EXAMINATION

Will be in the same form as original exam

GRADING

Grades are given according to the Danish 7 step and the Chinese 100 points grading scales.

Machine Learning in Neuroscience

5 ECTS

Module coordinator team

Denmark: Peter Mondrup Rasmussen, Associate Professor, CFIN, Department of Clinical Medicine, Aarhus University (pmr@cfin.au.dk)

China: Shihua Zhang, Professor, Academy of Mathematics and Systems Science, Chinese Academy of Sciences, (zsh@amss.ac.cn)

Aim

The aim of this course is to introduce machine learning techniques and enable students to apply these to complex data sets as typically encountered in neuroscience. The course introduces topics in i) supervised learning such as basic and advanced models for predicting continuous and discrete outcomes (regression and classification), ii) unsupervised learning such as cluster analysis and dimension reduction techniques, and iii) techniques for model training, -selection, and -assessment. The machine learning techniques are put into neuroscientific context through examples form neuroimaging research (e.g. brain network analysis and disease prediction).

LEARNING OBJECTIVES

Knowledge

At the end of the course the students will have gained knowledge of:

- Describe mathematical and statistical principles in supervised- and unsupervised machine learning.
- Describe basic and advanced models for predicting continuous and discrete outcomes, models for clustering and dimension reduction, and strategies for model selection and model assessment.
- Argue for or against different approaches based on their theoretical and practical strengths and weaknesses.
- Describe how the machine learning techniques can be used within the fields of neuroscience and neuroimaging (disease prediction and brain network analysis).

Skills

During the course the student will have obtained skills in order to:

- Identify relevant techniques to solve research-based problems within neuroscience
- Concisely account for solution strategy and analysis results, as necessary for publication in scientific journals or prototyping machine learning algorithms.
- Apply unsupervised and supervised learning techniques particularly within neuroscience research.

Competencies

The student is expected to gain the following competencies through the course:

- Independently develop analysis strategies and apply machine learning techniques to solve research-based problems within neuroscience.
- Become proficient in novel techniques (not covered in lectures) by studying and critically reviewing research articles.

Student requirements

Knowledge and competence within mathematics equivalent to the mathematics course in the master's program. Basic knowledge in biostatistics (ANOVA, regression).

EXAM

Oral examination.

The exam is a 20-minute oral examination of the topics covered in the course curriculum (textbooks, lecture slides/notes, exercises). The student randomly draws a question/topic and has 20 minutes for preparation with access to all aids. One sheet of hand-written notes may be brought from the preparation to the exam. The exam duration is 20 min, beginning with the student presenting. Internal sensor.

RE-EXAM

Will be in the same form as the original exam.

GRADING

Grades are given according to the Danish 7 step and the Chinese 100 points grading scales.

Integrative Neuroimaging

5 ECTS

CONTENT

Neuroimaging techniques are capable of probing physiology and function at molecular, cellular and system levels, in animal models and humans. However, each imaging modality has its unique strength and inherent limitations. Moreover, most imaging modalities are correlative in nature, precluding causal inferences. The aim of the Integrative Neuroimaging Course is to give the students the possibility to gain experience in the rapidly advancing field of multimodal imaging. The students will learn about when, why, and how to combine different imaging modalities. The course will provide the students with a "multimodal imaging framework" which will help them to critically interpret literature within the field and to optimally plan scientific projects in the field of brain imaging.

During the course, the following topics will be covered in overview lectures or exercises:

- Introduction into the concepts behind integrative multimodal imaging
- Introduction to standard neuroimaging analysis tools
- General analysis techniques useful for integration of modalities
- Integration of electrophysiology (EEG/ERP/MEG) and functional MRI
- Introduction to transcranial brain stimulation (TMS, TDCS) and deep brain stimulation
- Combining EEG and TMS/TDCS
- Neurostimulation and neuroimaging: TMS & fMRI, offline and online
- Integration of MR-related techniques: structural MRI (sMRI) and diffusion weighted MRI (DWI)
- Combining sMRI and functional MRI (fMRI)
- Combining DWI & fMRI
- Integrating DWI and TMS
- Integration of MR-based techniques with positron emission tomography

Recommended student requirements

Basic knowledge of the major brain mapping techniques (structural and functional MRI, diffusion sensitive MRI, PET, EEG, MEG)

Basic experience with Matlab, MRI and EEG data analysis software

LEARNING OBJECTIVES

Knowledge

By the end of the course, the student will have:

- acquired in-depth knowledge about how the combined use of brain mapping modalities can help overcome modality-inherent weaknesses and to maximize the modality-specific scientific potential.
- knowledge on standard analysis tools including statistical parametric mapping, analysis of event related potentials and unsupervised decomposition with applications in multimodal neuroimaging.
- basic knowledge about how to model multimodal imaging data.
- knowledge on how to critically review own and published multimodal results.
- the ability to understand, reflect over and explain how to best integrate two imaging modalities.
- acquired knowledge to be able to identify neuroscientific questions that can best be studied with an integrative neuroimaging approach.

Skills

The student will be able to:

- design a multimodal neuroimaging study: Identify the most relevant neuroimaging techniques, choose the most appropriate analysis tools and discuss strengths and weaknesses of different approaches.
- explain how to incorporate interventional approaches (TMS, TDCS) in brain mapping studies.
- explain the technical and computational challenges of multimodal integration.
- use and understand standard tools for analysis of neuroimaging data.
- co-register multimodal imaging data and integrate data sets acquired in different imaging modalities for subsequent analysis.
- evaluate the choice of method for multimodal integration.
- evaluate and choose the most appropriate neurostimulation techniques and protocols.
- account for solution strategy and analysis of results, as necessary for publication in scientific journals.
- disseminate knowledge about integrative neuroimaging and discuss related professional and scientific topics with both peers and non-specialists.

Competences

This course provides the students with the capacity to:

- overview complex experimental situations that require the integration of two imaging modalities.
- plan and pursue interdisciplinary cooperation with researchers using complementary imaging modalities.
- develop new ideas on how to improve multimodal integration and implement novel applications for integrative neuroimaging.
- acquired knowledge to be able to identify neuroscientific questions that can best be studied with an integrative neuroimaging approach.

EXAMINATION

The exam is a 4-day take home assignment.

The evaluation of the course is based on a written report. At the end of the course, students are presented with a research paper. The students are to write a report including a short summery and a discussion/review of the paper.

The extent of this written report should be no more than four pages, excluding illustrations, references, tables and figures. The students should attempt to integrate the knowledge obtained during the course in the evaluation of the research.

The following questions may serve as inspiration during preparation of the report:

What is the central question that the paper addresses?

What are the hypotheses?

What are the main results?

How can the results be interpreted?

Are there technical aspects, which may hamper or limit the interpretation of the results?

What multimodal imaging techniques are used in the paper or how can multimodal imaging techniques help in addressing the research question?

Which experiments may help address the research question?

Does the paper make a significant contribution to the field?

Evaluation will be based on internal censorship.

RE-EXAMINATION

Will be in the same form as original exam.

GRADING

Grades are given according to the Danish 7 step and the Chinese 100 points grading scales.

Advanced Magnetic Resonance Neuroimaging (elective)

5 ECTS

Course Coordinators: Fan Wang, Associate Professor, Institute of Biophysics, Chinese Academy of Sciences (fwang@bcslab.ibp.ac.cn), Rong Xue, Professor, Institute of Biophysics, Chinese Academy of Sciences (rxue@bcslab.ibp.ac.cn), Lars G. Hanson, Associate Professor, Technical University of Denmark – DTU (lghan@dtu.dk); Senior Researcher The Danish Research Centre for Magnetic Resonance (DRCMR), Copenhagen University Hospital Hvidovre.

AIM

The course aims at to give a comprehensive understanding of one of the most important imaging modalities for neuroscience, MRI. The emphasis will be on physical aspects including the relationship between design of key hardware components, signal processing and the quality of the final image data acquired. The course will provide the necessary skills for using spectroscopy, structural and functional MRI in neuroscience.

STUDENT REQUIREMENTS

Basic knowledge of calculus, physics, signal processing, programming and MRI. A basic understanding of medical imaging techniques. English language proficiency.

LEARNING OBJECTIVES

Knowledge

The student will gain knowledge about:

- theoretical description of spin dynamics, magnetization, and interaction between field and tissue.
- general design of magnet coil, gradient coil, RF coil, RF components in the RF transmission and receiving pathways.
- methods for spectroscopy, contrast selection, fast imaging, functional MRI (fMRI), ultra-high field MRI.

Skills

At the end of the course the student will be able to

- reflect on the physical limitations and advantages of MRI.
- perform data analysis and processing of data from structural and functional MRI studies.
- design and optimize advanced MRI protocols for best data quality.

Competences

The course enables the student to

- contribute with essential knowledge about MRI as a member of an inter-disciplinary research team.
- interpret data from MRI relative to a scientific question.
- give advice regarding assessment and selection of optimal MRI equipment suitable for various clinical and scientific purposes.

EXAMINATION

Obligatory reports following practical exercises (corrected, but not graded).

At least 50% presence during lectures/exercises is a requirement for attending the exam on which grading is based:

30 minutes oral examination without preparation time in two MRI topics drawn from a pool of at least 10 pre-announced topics relating to lectures and exercises.

RE-EXAMINATION

Same format as original exam

GRADING

Grades are given according to the Danish 7 step and the Chinese 100 points grading scales.

Advanced Neuroscience (elective)

5 ECTS

CONTENT

The objective of this course is to provide the student with a broad knowledge of current approaches for the study of neural function and behaviour.

The student should get an understanding of information processing in synapses, neurons and microcircuits; understand the experimental approaches used in analysing the neurophysiological basis of behaviour in intact animals and understand the use of animal models in the study of neurological disease. The course includes a wide variety of animal model systems used in neuroscience research, and techniques for genetic manipulation in both invertebrate (e.g. C. elegans, Drosophila) and vertebrate models. The students should be able to critically read and present the current literature and discuss the function and structure of neuronal circuits in relation to animal behaviour. This course provides an up-to-date knowledge of the neural basis for indirect measurements of global brain function such as PET and fMRI. As such, it provides insights useful when designing and interpreting experiments in human brain scanning studies. The course provides examples of genetics, signal processing, neural modelling and physiology used in the study of neural function in health and disease.

Recommended student requirements

Knowledge and understanding of basic neurobiology, physics, mathematics and signal processing, and electrophysiological and optical imaging methods, commensurate with a level at or above that which is the objective of the basic 1st. and 2nd.semester courses in neuroscience and neuroimaging. English language proficiency.

Module structure and teaching approach

Each subject will be covered by one original paper and possibly one review in double-lessons. One or two students (working as a team) will present the original paper (15 minutes), followed by a general discussion. In the second lesson a review may be presented by another student or by another pair of students (also 15 minutes presentations). Alternatively, only the original paper will be presented, and the review is expected to be read by the students in preparation. Both original papers and reviews will be used in the examination. Teachers will be from Chinese and Danish Universities affiliated with SDC. The teacher's role is primarily to guide the presentations in class, and to provide feedback.

All students are expected to actively participate in class. The course coordinators will (before the start of the course) allocate published papers/reviews for the students to present. It is a prerequisite for attending the oral exam that the student has presented two papers, one of these must be an individual presentation (to mimic the exam situation).

LEARNING OBJECTIVES

Knowledge

At the end of the course the student should be able to:

- demonstrate knowledge and understanding of molecular, genetic and physiological methods for measuring and manipulating brain function and behaviour.
- demonstrate an understanding of the strengths and limitations of the different animal models on the basis of their physiological and pathophysiological relevance and understand how to select the best animal model(s).
- demonstrate knowledge and understanding of the molecular, dendritic, cellular and circuit organization and physiology of the CNS in relation to the behavioural requirements and evolutionary adaptations of the organism.

Skills

During the course, the student will obtain the ability to:

- evaluate results derived from experiments performed in animals in neuroscience research.
- argue for the relative merits of the above methods and suggest new developments of methods and new physiological experiments.
- identify relevant animal models and experimental approaches to address a particular neuroscientific question.
- find, evaluate and present relevant current scientific literature.

Competences

By the end of the course the students have acquired the capacity to:

- critically understand modern molecular, cellular and behaviour-testing methods in relation to the analysis of neural information processing and brain function in health and disease.
- perform independent as well as in teamwork, trans-disciplinary scientific projects using a variety of physiological methods for the analysis of brain function.
- analytically evaluate his/her own and general knowledge and understanding of brain function and indicate avenues for further improvements.

EXAMINATION

Exam format: Oral examination based on the papers/reviews presented during the course.

Examiners: Teachers from the course.

The exam duration will be 35 minutes (followed by 5 minutes for evaluation). The first part (15 minutes) consists of a paper presentation by the student, followed by 20 minutes of discussion.

Each student will be assigned a paper for presentation 48 hours prior to the examination. During the 48 hours, the student is expected to produce an exam-PowerPoint presentation of the paper. The exam-paper will not be the same as the one(s) the student has presented in class during the course but will be one of the papers presented by other students during the course.

When evaluating the exam, it is important that the student has shown the ability to present the paper in a concise fashion, using effective presentation techniques. The main emphasis is on the ability to extract the important points of the paper, to argue why things have been included in the exam-presentation, to evaluate the paper in a critical fashion, and to put the findings and conclusions of the paper into a wider context, for instance based on the course literature and material found by the student.

RE-EXAMINATION

Will be in the same form as the original exam.

GRADING

Grades are given according to the Danish 7 step and the Chinese 100 points grading scales.

Cognitive Science (elective)

5 ECTS

CONTENT

The students will be introduced to cognitive science emphasising the functional aspects of the human brain that govern everyday behaviour, such as; attention, memory, problem solving, etc. The course is based on a number of lectures in combination with student participation in workshops and exercises. Here the students will conduct small behavioural experiments, typical relating to some of the classical studies in cognitive science (e.g. visual search (Treisman & Gelade, 1980), the serial positioning curve (Glazer and Cunitz, 1966) in free recall, etc.). The overall goal is to give the course participants a thorough introduction to cognitive science and behavioural methods.

Recommended student requirements

An understanding of the content covered in the courses BNS and NNPN. A basic knowledge of the major imaging techniques (structural and functional MRI, diffusion sensitive MRI, PET, EEG, MEG). English language proficiency.

Module structure and teaching approach

Combined lectures, with student activities. The student activities can take the form of small behavioural experiments that may provide the empirical data for one of the two final synopsis papers, classroom presentations, as well as group work.

LEARNING OBJECTIVES

Knowledge

During this course, the student will obtain:

- knowledge about the historical roots and foundation of cognitive science.
- knowledge about specific cognitive functions (e.g. memory, attention, emotions, etc.).
- knowledge of behavioural experiments that can provide the basis for further neuroscientific enquiries.

Skills

By the end of the course the student will be able to:

- disseminate theoretical knowledge about cognitive science and experimental results.
- conduct behavioural experiments investigating human cognition.
- devise, design, and set-up simple behavioural experiments within cognitive science.

Competences

The course provides the student with the ability to:

- critically review scientific publications dealing with topics relating to cognitive science, and cognitive neuroscience more broadly.
- select suitable methodologies for studying cognition.
- reflect behavioural test designs and propose research solutions.

EXAMINATION

The exam is an oral synopsis exam. Examiners will be teachers from the course.

By 9 am the day before the exam, the student must hand in two synopsis papers, one theoretical and one empirical, the maximum size of a synopsis is three pages each (times new roman, pt. 12, 1.5 line spacing). The topics should not be too overlapping and needs to be approved by the course coordinator before the final exam. A synopsis is a short academic text, based on the course literature, and may include supplementary literature chosen by the student.

The oral part of the exam is 30 min. The student will enter the examination room and choose one of the two synopsis papers at random, which will be the basis for the exam. Then the student will have 7 min to make a brief presentation, followed by an examination based on the chosen synopsis (approximately 7 min) and the broader course curriculum (approximately 7 min), leaving the remaining time for the examiner and censor to discuss the final grade and give feedback.

RE-EXAMINATION

Will be in the same form as the original exam.

This is a new oral synopsis exam, based on new topics that are not too overlapping with previous chosen topics (for specifics on format please cf. to the above section), and these need to be approved by the course organiser before a re-examination.

GRADING

Grades are given according to the Danish 7 step and the Chinese 100 points grading scales.

Public Management and Social Development

Business and Global Governance

7.5 ECTS

Course coordinator: Morten Ougaard (mo.ioa@cbs.dk)

CONTENT

This course provides students with an introduction to the global context in which public and private actors operate and seek to realize goals. The course addresses theories within International Political Economy and introduces students to a range of the main international political economic processes and international organisations that condition the environment in which public and private actors both operate and constitute. Students are expected to deploy and evaluate these theories against detailed cases in the international arena.

Issue areas covered in the course include, not exhaustively, international finance, production, trade, law, taxation and the environment.

Students submit research papers at the conclusion of the course based upon the issues covered in the course. There will be guidance provided on developing research questions. Seminars running parallel to classes are used to assist students in building the research paper and reflect upon content.

LEARNING OBJECTIVES

At the end of the course the students should be able to:

- recognise, describe, evaluate and deploy analytically key theories and theoretical traditions in international political economy.
- identify central processes, institutions and actors in the global political economy and how these processes, institutions and actors' impact on the constitution of the international political economy.
- use this knowledge to formulate and respond persuasively to research questions about the international political economy.

EXAMINATION

Individual research report (10 standard pages) based on a self-chosen topic. The research question is to be based on topics covered during the course.

RE- EXAMINATION

The re-examination is subject to the same regulations as the ordinary exam.

GRADING

Grades are given according to the Danish 7 step and the Chinese 100 points grading scales.

Comparative Policy Processes

7.5 ECTS

Course coordinator: Edward Ashbee (ea.dbp@cbs.dk)

CONTENT

The aim of this course is to introduce and explore different theoretical frameworks that can be used in undertaking a comparative study of policymaking processes. These include power-based approaches, structural explanations of policymaking, and institutionalist theories, as well as advocacy coalition and rational choice models. The course's coverage of these will incorporate an evaluation of the methodological challenges that arise when seeking to operationalise them. The course will at the same time consider the specific issues that arise when seeking to look at - and compare - policymaking processes in different time-periods or countries.

LEARNING OBJECTIVES

Following the successful completion of the module, participants should be able to:

- identify and assess the criteria to be used in comparing public policymaking processes across different national settings.
- identify, analyse and evaluate key concepts, models and theories in the study of policymaking processes and the assumptions that underpin them.
- relate core concepts, models and theories to empirical evidence.
- identify and assess the key methodological issues that arise when particular approaches to policymaking processes are operationalised.
- identify and assess the major contemporary challenges facing policymakers in different countries, settings and sectors.
- undertake a comparative theoretical and empirical study of policymaking processes based upon structured and coherent forms of argumentation.

EXAMINATION

The exam will be an individual assignment (10 standard pages) based upon a question or questions set by the teaching staff. The question(s) will draw upon the classes and the readings, and the assignment will be assessed based on the learning objectives for the course.

RE- EXAMINATION

The re-exam is subject to the same regulations as the ordinary exam.

GRADING

Grades are given according to the Danish 7 step and the Chinese 100 points grading scales.

Social Innovation and Entrepreneurship

7.5 ECTS

Course coordinator: Liana Razmerita (lra.msc@cbs.dk)

CONTENT

The course will help students understand processes underlying social innovation and entrepreneurship. The students will be introduced to the theory and practice of busine model development through knowledge collaboration in relation with Sustainable Development Goals (SDGs).

Students will work in teams to identify a real-world opportunity in different forms of innovation that will create charitable or societal benefits, either being developed in the public or private sector. They will then be required to "transfer" this knowledge into the real world. The students will also gain hands-on experience with the practice of social business modelling and the systematic management of knowledge in the development of these business models. They will use the digital technologies (e.g., Babele as a virtual open innovation platform) to identify and describe the business model, determining relevant market segments, income strategies, and financing models. The course will be completed with the students presenting their business models and opportunities.

The course will include lectures and case studies but will consist primarily of team-based work on your social enterprise business models.

The course will develop capabilities in social opportunity identification as well as the writing of business plans for social enterprises. The students will be introduced to the disciplines of business modelling and management of knowledge work. They will learn how to identify ideas for social innovation that will help create charitable or societal benefits and how to use collaboration and social networking to develop and leverage social innovation. In particular, the course will ask the students to set up their own social enterprise during the course, which will expose them to the practical challenges associated with launching social ventures.

One main element of the course is the development of a business plan. For this purpose, students work in groups together.

LEARNING OBJECTIVES

At the end of the course, students should be able to:

- discuss the differences between different theories of social innovation.
- explain how these theories link to social performance.
- explain the opportunities and challenges in managing knowledge work for social innovation
- reflect on how knowledge processes and strategies can be used to leverage social innovation
- define which variables impact the social performance of social enterprises.
- apply classroom learning to a specific real-world example for which a business plan must be prepared and defended.

EXAMINATION

Individual 20 minutes oral exam based on a 10-page group mini project. In the group mini project, the students must select a social issue (e.g., health, microfinance or unemployment related), identify a social innovation opportunity and develop a social business model. In the mini project the students will have to reflect critically on the group's work drawing on the course literature. The students are expected to reflect both on the group's social enterprise's business model as well as the group processes in relation to (virtual) collaboration and knowledge management.

RE- EXAMINATION

The re-exam is subject to the same regulations as the ordinary exam.

GRADING

Grades are given according to the Danish 7 step and the Chinese 100 points grading scales.

Comparing Social Policies: Welfare States in Theory and Practice

7.5 ECTS

Course coordinator: Kristian Kongshøj (kongshoj@dps.aau.dk)

CONTENT

This course introduces basic theoretical and empirical perspectives on welfare states and the various ways of meeting social needs in different social systems.

The course includes theories and methods of policy analysis and their application to policy development and institution building in the welfare area.

Furthermore, the course elaborates on various challenges to welfare states all over the world. In many countries, these challenges have been reinforced by economic crisis. This adds to a long list of challenges for mature as well as for new welfare states: ageing populations, migration, poverty, new social risks, changing family patterns, social cohesion, etc.

The aim of the course is to compare these challenges across different social systems and welfare regimes. It examines the drivers of change as well as constraints on change in terms of path dependence and institutional complementarity. It addresses how possible solutions vary with the different combinations of social actors and institutions in the environment: states, markets, families, voluntary associations, social partners, and corporate social responsibility.

LEARNING OBJECTIVES

At the end of the course, students should be able to:

- undertake an in-depth comparative analysis on a selected topic within social policy.
- conceptualise and analyse the effects of different welfare state arrangements on social equality, economic efficiency and political stability.
- conceptualise and analyse challenges to the welfare state emanating from social risks and different forms of social change in different settings.
- identify, discuss and evaluate solutions suggested to the kind of welfare challenges covered in the course.

EXAM

The examination form is an individual report. The teaching team formulates 3-4 exam questions on topics from the course. The questions will be available one week before the final hand-in date. The issues will range from questions that can be answered solely by understanding the course and the course literature to questions that require independent or critical discussion on theoretical or empirical issues. The teaching team will provide the supplementary empirical material or case material needed for an excellent answer to these questions, but students are also welcomed to include literature or material of their own if it is relevant to the exam.

The written report should be no more than 10 standard pages in length, excluding the cover page, table of content, list of references, and appendix.

Reports will be graded based on the following criteria. The excellent report is based on the ability to:

- understand and explain topics and literature from the curse.
- carry through an analysis of the provided material with reference to the course and course literature.
- independent selection of relevant theories and concepts from the course to critically discuss challenges for contemporary welfare states.

During the course, exercises and questions during seminars will also facilitate discussion between students and teachers on how to engage and answer questions from the field of welfare and social policy. At the end of the course, we also schedule a separate Q&A on the specific questions that are posed in the exam.

RE-EXAM

The re-exam is subject to the same regulations as the ordinary exam.

GRADING

Grades are given according to the Danish 7 step and the Chinese 100 points grading scales.

Thesis (4. Semester)

30 ECTS

Course responsible: Duncan Wigan (dw.dbp@cbs.dk)

CONTENT

The thesis addresses a student-developed problem statement, which is relevant to the programme. It should demonstrate that the student is able to formulate and delimit a research problem, and that the student can design and carry out an inquiry suitable to the problem at hand by:

- being situated in, drawing upon and evaluating social science literature relevant to the problem.
- selecting, evaluating and applying appropriate social science theories and methods.
- compiling and analysing suitable empirical data and evidence.

Students should be able to draw substantiated conclusions and discuss the quality of thesis findings.

The thesis can be written in collaboration with an organization, focusing on a topic of particular interest to that organisation. However, the thesis is evaluated solely on academic grounds.

Students will be provided with guidance during the thesis and will have a Danish and Chinese supervisor.

LEARNING OBJECTIVES

After having completed the master's thesis, students should be able to:

- formulate, delimit and operationalise a research question in an area of relevance to the programme.
- select, apply and critically evaluate relevant theories and scientific methods.
- collect, deploy and critically evaluate relevant empirical material.
- persuasively justify the analysis and assess the strengths and weaknesses of the thesis.

  present the results of the analysis in a logically coherent, structured and linguistically adequate manner.

EXAMINATION

The thesis is an individual written assignment. The length of the thesis is 60-80 standard pages.

Students must include a summary to the thesis in English.

The examination (defence) is oral, based on the thesis. It takes the form of a dialogue between the student and the examiners that make up the Thesis Defence Panel.

The duration of the oral examination is 60 minutes including grading. The students have maximum 12 minutes to present the thesis.

The grade awarded reflects an overall assessment of the written thesis and the oral defence.

The assessment is made by the Thesis Defence Panel, which includes an external examiner.

RE-EXAMINATION

Re-examinations are subject to the same regulations as the ordinary exam

A revised version of the thesis can be based on a new or revised subject.

GRADING

For the Danish/international students, grades are given according to the Danish 7 step and the Chinese thesis grading scales.

For the Chinese students, grades are given according to the Danish 7 step grading scale only.

The details of the thesis procedure are described in SDC Thesis Regulations 10 Steps.

Water and Environment

Statistics, Modelling and Global Change (Module 3)

15 ECTS

CONTENT

The objective of this course is to provide students with knowledge and tools to:

- understand and apply frequently used data analysis and statistics, which are necessary for their future work and research.
- understand and apply GIS-based geospatial analysis for environmental mapping and analysis at small to large spatial scales.
- understand and - through simulation models - quantify the interactions between climate forcing, land use, water resources and surface water quality.
- understand and quantify the processes of carbon and nitrogen flows in ecosystems (soils, plant communities and animals) and the resulting effects on greenhouse gas emissions, climate change and feedbacks to ecosystems.
- The course comprises a combination of out-of-class and in-class activities, including lectures, theoretical exercises and computer exercises. Computer exercises will be based on topics and case-studies presented at lectures.

LEARNING OBJECTIVES
After completion of the course, the students should be able to:

Knowledge

- understand the logic underlying commonly used statistical procedures, including regression models and analysis of variance.
- describe and explain general methodological approaches and their problems in GIS-based geospatial data handling and modelling, as well as spatial statistical analysis.
- identify relevant tools and models that can quantify how climate forcing (e.g., CO_2, temperature, precipitation and irradiance) and land use influence water resource availability and surface water quality.
- describe and explain greenhouse gas emissions from ecosystems and the effects of climate variability and climate change on ecosystem functioning at different spatial scales (ranging from plant, ecosystem to global).

Skills

- apply frequently used data manipulation and statistical procedures, such as regression models, analysis of variance and graphical presentations.
- apply tools and statistical analysis for GIS-based geospatial data.
- apply and demonstrate the use of eco-hydrological models for river basin water resources management and scenario simulations.
- be able to quantify measures for reducing greenhouse gas emissions from agriculture and forestry with respect to efficiency, including the accounting of possible side effects on the environment and ecosystem services.

Competences

- assess and discuss the methodological approaches used in GIS-based geospatial data handling, modelling as well as spatial statistical analysis.
- collect, handle and analyse datasets at small to large spatial and temporal (time) scales, in relation to describing and understanding river basin dynamics, aquatic ecosystems and global changes.
- assess, discuss and propose how various management scenarios may influence water resources and water quality.
- describe and discuss measures for reducing greenhouse gases from managed ecosystems and adapting managed and natural ecosystems to climate change and describe the possible consequences of such measures.

EXAMINATION
The exam is a 3-hour written multiple choice exam with 40 questions of equal weight.
No aids. Only calculator is allowed at the exam.

RE-EXAMINATION
The re-exam is subject to the same regulations as the ordinary exam.

GRADING
Grades are given according to the Danish 7 step and the Chinese 100 points grading scales.

Integrated Water Management and Legislation (Module 4)

15 ECTS

CONTENT

The objective of the module is to provide knowledge and understanding on:

- major flows of water and nutrients (mainly nitrogen and phosphorus) in freshwater and agroecosystems across different climates, their role in pollution and restoration.
- managing urban water flows and sustainable urban development, as well as legislation, policy and planning of water and nutrients (mainly nitrogen and phosphorus).
- analysis of qualitative and quantitative data and writing scientific report.

The module offers an in-depth and up-to-date knowledge in the following areas (sub-modules):
Freshwater ecosystem management

- Introduction to nutrient (nitrogen and phosphorus) loading to streams, lakes and reservoirs in different climate zones, effects of nutrient loads on primary producers, consumers and water quality
- Physico-chemical and biological methods for restoration of lake/reservoir, including reduction of nutrient loads and shift to a clear-water state (biomanipulation)
- Methods for restoration of streams, including effects of re-meandering that improve the physical variations in streams and reduce plant harvesting

Agricultural water and nutrients management

- Water dynamics in the soil-plant-atmosphere continuum, water balance and crop water productivity
- Turnover of nitrogen and phosphorus in the soil, effect on plant nutrient availability and deficiency diagnosis
- Methods to improve water- and nutrient use efficiency, balance crop production and environmental protection

Water legislation and policy

- Introduction to water legislation in China and the EU, with focus on policy for water quality and integrated water resource management
- Main water policy instruments, including economic, information/voluntary and command-and-control-regulation; environmental policies and challenges in fulfilling policy aims
- Water planning, including spatial planning principles, approaches and challenges in water management and cross-sectorial planning and policy integration

Urban water management

- Introduction of urban water systems, challenges and trends in water solutions, including water supply and treatment systems, urban drainage and conventional stormwater management
- Non-conventional stormwater management, ecosystem services, aquatic ecological restoration in inland urban lakes
- Introduction to urban development and management towards sustainable development

The teachings of all sub-modules comprise lectures, theoretical exercises and project work in combination with visits/tours to ongoing projects on urban, fresh- and agricultural water and nutrients management in China. The topics of the theoretical exercises correspond to the topics presented in the lectures. Each project is typically conducted in groups of students and presented as a report and an oral presentation.

LEARNING OBJECTIVES

Following the successful completion of the course, the students will be able to:

- describe the main flows of water and nutrients (mainly nitrogen and phosphorus) in freshwater, agroecosystem and urban systems, their management and policy framework.
- conduct field work, integrate qualitative and quantitative data with scientific materials for problem-solving.
- write scientific report.

sub-module: Water legislation and policy

- identify relevant legal, policy and planning mechanisms in water management.
- critically evaluate main legal principles governing water management in jurisdictions in China and the EU.

sub-module: Urban water management

- critically evaluate urban water systems.
- suggest environment friendly solutions for urban water issues.

sub-module: Freshwater ecosystem management

- compare methods for reducing nutrient loading to surface- and ground waters.
- critically evaluate freshwater restoration and management case studies.

sub-module: Nutrients management in agroecosystems

- quantify water- and nitrogen relations in soil-plant-atmosphere continuum and generalize crop production.
- critically evaluate water- and nitrogen-saving strategies for agroecosystem and apply numerical modelling.

EXAMINATION

The exam comprises of:

- three assignments, each accounting for 15%, i.e., 45% of the total grade
- written 4-hour examination, accounting for 55% of the total grade. No aids, besides calculator, are allowed

The three assignments are conducted in groups and are accompanied by individual oral presentation and questions. Each group consists of 3-4 members, and the topics are fixed. The length of the assignments is 2-4 standard pages. The assignments are focused on the main learning objectives of the sub-modules.
The written examination is a 4-hour examination with physical presence and based on short questions related to the learning objectives, requiring short text answers and/or calculations. The questions cover the full module. No aid, other than calculator, is allowed.

RE-EXAMINATION

The re-exam is a 4-hour examination with physical presence based on short questions related to the learning objectives, requiring short text answers and/or calculations. The questions cover the full module. No aid, other than calculator, is allowed.

GRADING
Grades are given according to the Danish 7-point and the Chinese 100 points grading scales.