

# Studieplan 2019/2020

## Master`s Degree in Applied and Commercial Biotechnology

**Studiepoeng: 120**

### Studiets nivå og organisering

#### Study length and academic level

The Master`s Degree Programme comprises two years of full-time study (120 ECTS credits) that may also be completed part-time, and includes modules each totalling 5 – 20 ECTS credits. Given courses each totalling 5 - 15 ECTS credits, and a master`s degree thesis of 60 ECTS credits in experimental or 30 ECTS credits in Commercial biotechnology.

The study may also be completed part-time.

This biotechnology master study is unique by having a two-tailed specialisation possibility, either in Experimental Biotechnology or in Commercialisation of Biotechnology direction. Chosen specialisation is based on chosen courses and in master`s degee thesis. Further, this study is taught in English, giving it an international perspective and recruit possibilities.

### Bakgrunn for studiet

#### Introduction

Biotechnology entails the utilisation of microorganisms, animal and/or plant cells to create useful and necessary products, and further provides the means for the genetic modification of living organisms and their function. In the years to come, biotechnology will play an increasingly important role in how society develops. Genetic engineering can, for instance, help in the development of new and improved vaccines. Biotechnology can be used as a tool to elucidate basic biological processes, but may also be used in diagnostics, for hygienic control, for the purification of water, raw materials, finished products, for bioproduction processes and for dealing with waste products and pollution.

Enterprises and companies in a rapidly growing biotechnological industry experience an increasing demand for qualified workers. The study programme prepares students for work in the biotechnological and pharmaceutical industries, the food processing industry. Students with an cross-disciplinary approach to biotechnological problems are well suited to work in both public and private research and development laboratories.

### Læringsutbytte

#### Learning outcomes /Læringsutbytte

##### *Knowledge:*

The candidate

- has advanced cross-disciplinary approach to biotechnological problems
- has advanced knowledge of methods used in biotechnological companies as gene technology, cell biology and bioprocess engineering
- has advanced knowledge about the commercialisation of biotechnology in order to develop marketable products based on promising research results

***Skills:***

The candidate

- can meet the increasingly cross-disciplinary demands of an expanding biotechnological business sector
- has thorough hands-on laboratory experience and theoretical competence in Cell and Reproduction Biology, Molecular Biology and Bioprocess Technology
- can establish biotechnological enterprises based on their own research, using Intellectual Property Rights (IPR) strategies and developed business plans
- can analyse and critically reflect on ethical problems involving biological organisms, as well as environmental ethics as related to biotechnological products, and to see them in a larger scientific context

***General competence:***

- has advanced theoretical knowledge and practical skills making them well equipped for a career in biotechnology-based activities
- has advanced knowledge and skills in biotechnological subjects so they can analyze and complete a piece of original research
- can communicate independent work within the academic field of biotechnology

## **Målgruppe**

### **Target group**

Our aim is to target students globally to this study programme, who already have a foundation in biotechnology, and who wish to acquire advanced theoretical knowledge and practical skills in biotechnology. Primarily we target students with a bachelor in biotechnology, but we also encourage applicants with other bachelor degrees as long as they fulfil the entrance requirements (see Admission requirements below).

## **Relevans for arbeidsliv og videre studier**

### **Qualification attained**

The Master's Degree Programme in Applied & Commercial Biotechnology leads to a Master's Degree in biotechnology, with specialisation in either "Experimental biotechnology" or "Commercialisation of Biotechnology" fields. Expertise in biotechnology can be utilised in basic and/or applied research

focusing on the economic and socially beneficial use of organisms and their products, or to help stimulate the establishment of biotechnological enterprises.

## Opptakskrav og rangering

### Admission requirements

For both specialisation modules of the programme, your degree from higher education must fulfil the following requirements:

- The equivalent of at least 80 ECTS credits in natural sciences and mathematics, with a solid foundation in chemistry and biology. Coursework in biochemistry must be included, with a minimum grade of C.
- A minimum average grade of D for the 80 ECTS credits.

For students taking the Experimental Biotechnology specialisation, and who want to perform Master's thesis work in molecular biology, the degree from higher education must in addition include coursework in molecular biology with a minimum grade of C. Students lacking molecular biology coursework may qualify for molecular biology thesis work by taking a Bachelor-level molecular biology course at INN University.

English Language requirements:

[See complete language requirements](#)

## Arbeids- og undervisningsformer

### Teaching and learning methods

The instruction is based on lectures, workshops/group work, laboratory exercises and excursions. All students working toward a Master's Degree in Applied & Commercial Biotechnology will be enrolled in obligatory courses comprising the subjects. Introductory lectures and practical learning exercises on the computer followed by a hand-in assignment that is to count as a part of the total assessment of the students. Synopses of these assignments are presented by students in short lectures to the instructors and the remaining students. Lectures also include group discussions, individual assignments, group assignments and quizzes. See detailed description for each courses below.

## Vurderingsformer

### Assessment methods

There are varied assessment methods, both regarding intermittent assessment and final assessment. These are: Written examination, oral examination, laboratory reports, project reports, hand-in assignments and portfolios. Oral presentation of thesis is part of final remarks. A letter grading scale is used. A more detailed description is given in the course descriptions below.

## Forskningsbasert undervisning

All lectures are based on scientific experience, and the students are involved with their supervisor(s) scientific programs in the Master`s Thesis work.

## Internasjonalisering

### Internationalisation

The biotechnology master study programme is entirely taught in English, which allow for international applicants as well as local ones. The entire curriculum is in English. We recruit students globally, and therefore we have an international environment at Hedmark University College. Natural science is an international oriented subject. Biotechnological Professors therefore have international colleagues and cooperations with students involved. Students sometimes visit interational contacts.

## Studiets oppbygging og innhold

### Content and organization

Specialisation 1) Experimental Biotechnology:

- 2BIO012 Bioinformatics/Biostatistics (15 ECTS credits)
- 2BIO021 Bioethics (5 ECTS credits)
- 2BIO033 Methods in Cell and Reproductive Biotechnology (10 ECTS credits)
- 2BIO034 Methods in Molecular Biology (10 ECTS credits)
- 2BIO035 Bioprocess Technology (5 ECTS credits)
- 2BIO052 Bioeconomy and Biobusiness I (15 ECTS credits)
- 2BIO 201 Master`s Degree Thesis in Experimental Biotechnology (60 ECTS credits)

Specialisation 2) Commercialisation of Biotechnology:

- 2BIO012 Bioinformatics/Biostatistics (15 ECTS credits)
- 2BIO021 Bioethics (5 ECTS credits)
- 2BIO043 Biotechnological Methods (15 ECTS credits)
- 2BIO052 Bioeconomy and Biobusiness I (15 ECTS credits)
- 2BIO063 Bioeconomy and Biobusiness II (10 ECTS credits)
- 2BIO064 Methods in biobusiness (5 ECTS credits)
- 2BIO065 Entrepreneurship (15 ECTS credits)
- 2BIO066 Development of bioproducts and services (10 ECTS credits)
- 2BIO203 Master`s Degree Thesis in Commercial Biotechnology (30 ECTS credits)

## Informasjons- og kildekompetanse

### Information literacy

Instruction in information literacy is included as a topic in the theoretical curriculum and is linked to the students` work on writing assignments. The students will receive training about how to search for

information and evaluate different sources of information. Emphasis is placed on the students understanding when acquisition of reference information is necessary, and independently being able to find, evaluate and make use of information in their own learning. Use of the University College's e-learning systems will constitute an integrated part of the instruction. The library staff will be responsible for instructing the students.

## Godkjenning

## Kull

2018

### Specialisation in

Emnekode	Emnets navn	S.poeng	O/V *)	Studiepoeng pr. semester			
				S1(H)	S2(V)	S3(H)	S4(V)
2BIO021	<u>Bioethics</u>	5 credits	O	5			
2BIO052	<u>Bioeconomy and Biobusiness I</u>	15 credits	O	15			
2BIO012	<u>Bioinformatics/Biostatistics</u>	15 credits	O		15		
Specialisation Experimental Biotechnology:							
2BIO033	<u>Methods in Cell and Reproductive biotechnology</u>	10 credits	V	10			
2BIO034	<u>Methods in Molecular Biology</u>	10 credits	V		10		
2BIO035	<u>Bioprocess Technology</u>	5 credits	V		5		
2BIO201	<u>Master's Degree Thesis in Experimental Biotechnology</u>	60 credits	V		10		60
Specialisation Commercialisation of Biotechnology:							
2BIO043	<u>Biotechnological Methods</u>	15 credits	V		10		
2BIO063	<u>Bioeconomy and Biobusiness II</u>	10 credits	V		5		
2BIO064	<u>Methods in biobusiness</u>	5 credits	V			5	
2BIO065	<u>Entrepreneurship</u>	15 credits	V			15	
2BIO066	<u>Development of bioproducts and services</u>	10 credits	V				10
2BIO203	<u>Master's Degree Thesis in Commercial Biotechnology</u>	30 credits	V				30
				Sum:	0	0	0

\*) O - Obligatorisk emne, V - Valgbare emne

# Emneoversikt

## 2BIO021 Bioethics

Emnekode: 2BIO021

Studiepoeng: 5 credits

### Semester

Høst

### Språk

English

### Krav til forkunnskaper

Prerequisites: None

### Læringsutbytte

#### Learning outcomes

A student having completed the course have the following learning outcomes:

#### *Knowledge:*

The Student

- has knowledge of ethic subjects
- has knowledge of consequence and risk assessment as well as ethical argumentation
- has knowledge of legislation in this area and the major parties and authorities to which the researchers must relate

#### *Skills:*

The Student

- can identify ethical challenges
- can analyze and critically reflect on problems involving animal ethics as well as environmental ethics as related to biotechnological products, and to see them in a larger scientific context

### Innhold

## Content

- Ethics and ethical assessments
- Risk assessment, legislation as to patenting laws in various countries
- The Biotechnology Act and acts concerning the use of animals in research.
- Ethical, environmental, legal and social aspects of modern biotechnology
- Research-based knowledge in the field
- Legislation in the field of biotechnology, and information about which relevant major parties and authorities to which researchers must relate

## Arbeids- og undervisningsformer

### Organization and Methods of Instruction

- Lectures
- Ethical discussions, individual and in groups
- Term assignments. Synopses of these assignments are presented by students in short lectures to the instructors and the remaining students

## Obligatoriske krav som må være godkjent før eksamen kan avlegges

### Requirements necessary to take the exam

Presence at 80% of scheduled classes

## Eksamen

### Assessment

- written individual 3-day home exam

The grading system is based on the letters from A-F, where E is the minimum passing grade

## Ansvarlig fakultet

Fakultet for anvendt økologi, landbruksfag og bioteknologi

## 2BIO052 Bioeconomy and Biobusiness I

Emnekode: 2BIO052

Studiepoeng: 15 credits

### Semester

Høst

### Språk

English

### Krav til forkunnskaper

Prerequisites: None

### Læringsutbytte

#### Learning outcomes

Upon successful completion of the course, the student will have achieved the following learning outcomes:

#### *Knowledge:*

The Student

- has knowledge of patent protection of inventions and other Intellectual Property Rights (IPR)
- has advanced knowledge of innovation, business models, sales- and marketing of biotech products and business financials

#### *Skills:*

The Student

- has good skills in establishment of IPR including patents, copyright and trademarks
- has thorough skills in the use of IPR in biotechnology and how to make use of it in business
- can classify inventions and innovations
- can carry out and give good suggestion to appropriate business models and sales- and marketing strategies, and to prepare a sales- and marketing plan
- can give advanced analyzed annual reports for “simple” companies, and to prepare budgets for projects and sales forecasts

#### *General competence:*

The Student

- can analyze and prioritize business opportunities with respect to profitability and choice of customer- and market segments
- can evaluate when and how to protect intellectual property in bioeconomy/biotech business

## **Innhold**

### **Content**

#### *Intellectual Property:*

How to protect such property and how the IPR law is working in Europe and US. The different strategies for biotech companies to protect its IPR and ensure its “freedom to operate” in business. In addition, licensing of IPR.

#### *Innovation:*

The different classes of innovation (incremental, radical, disruptive, open and closed innovation). Creativity and idea generation. 10 types of innovation (product, service, business models etc.), methods for developing ideas into innovations (e.g. Design Thinking and biomimicry). Theories on why innovations fail in the market and how to prevent it.

#### *Accounting:*

Double-entry book-keeping, preparing and analyzing financial reports (income statements, balance sheets and cash-flow statements), management accounting (budgeting and forecasting).

#### *Business models:*

Different business models relevant to biotechnology and bioeconomy companies. Osterwalder business model canvas and value creation.

#### *Commercialization:*

Market segmentation and calculation of market size, analyzing the market and opportunities (SWOT analysis), selecting the beach-head markets, technology adoption, product-, sales- and marketing strategies including the 4 P’s marketing mix (product, place, price and promotion), sales- and distribution channels, the importance of branding and launching a product to global markets.

## **Arbeids- og undervisningsformer**

### **Organization and Methods of Instruction**

The course is delivered as weekly lectures combined with case studies and visits to relevant companies and institutions. There will also be guest lectures given by founders and business leaders in companies in the region. Students are expected to participate in class discussions.

## **Obligatoriske krav som må være godkjent før eksamen kan avlegges**

### **Requirements necessary to take the exam**

- 2-3 individual assignments during the course
- a minimum of 80% presence in scheduled classes

### **Eksamen**

#### **Assessment**

- individual oral examination in themes from the curriculum and assignments. The examination consists in short and concise student presentations on themes selected at random from a list, and questions related to this and the assignments returns.

The exam will be evaluated by letter grade, A-F, where E is the lowest passing grade.

### **Ansvarlig fakultet**

Fakultet for anvendt økologi, landbruksfag og bioteknologi

## 2BIO012 Bioinformatics/Biostatistics

Emnekode: 2BIO012

Studiepoeng: 15 credits

### Semester

Høst

### Språk

English

### Krav til forkunnskaper

Prerequisites: None

### Læringsutbytte

#### Learning outcomes

Upon successful completion of the course, the student will have achieved the following learning outcomes:

#### *Knowledge:*

The Student

- has advanced knowledge of topics, algorithms, tools and methods in the field of Bioinformatics
- has knowledge of statistical methods for analysis of biological data

#### *Skills:*

The Student

- can analyze and use bioinformatic methods associated with advanced sequence alignment, database searches, genome analysis and protein structural studies
- can use statistical operations in biology

#### *General competence:*

## The Student

- can operate commonly used bioinformatics tools and understand their pros and cons
- can statistically analyse data in a biologically relevant manner

## Innhold

### Content

Bioinformatics is a branch of science that uses computers for storage, retrieval, analysis, visualization and distribution of information related to biological macromolecules like DNA, RNA and proteins. It is an interdisciplinary field that includes biology, computer science, chemistry and statistics.

This course introduces key concepts and methods in bioinformatics. Major research topics in bioinformatics include sequence analysis structure analysis and functional analysis of biological data.

The course comprises two main parts:

1. A lecture-based part, introducing various web-based resources and bioinformatics tools for the analyses of DNA, RNA and protein sequences and lectures in elementary statistics.
2. Computer lab, where students will be guided through practical bioinformatics and biostatistics exercises on the computer.

Topics covered include

- Introduction to biological databases and database searching
- Pairwise and multiple sequence alignment
- Phylogenetic analysis
- Protein structure modelling
- Gene prediction
- Basics of genome sequencing and genome assembly
- Introduction to elemental statistical treatment of biological data

## Arbeids- og undervisningsformer

### Organization and Methods of Instruction

- Lectures: Introductory lectures are given to provide an overview of the main topics in the course.
- Computer Lab: Practical exercises throughout the whole semester where the students will conduct a series of adapted computer tools to solve bioinformatics tasks
- Compulsory Assignment: Students in groups of 3-4 are to hand in a written report of an assigned bioinformatic problem

- Fronter: All relevant course information and scientific articles in the syllabus will be posted on Fronter.

## **Obligatoriske krav som må være godkjent før eksamen kan avlegges**

### **Requirements necessary to take the exam**

- Attendance to at least 80% of the Computer Lab exercises

## **Eksamen**

### **Assessment**

- written individual report count 40% of the final grade
- individual 4-hour written exam count 60% of the final grade

Both exams must be passed to receive a final grade.

The exam will be evaluated by letter grade, A-F, where E is the lowest passing grade

## **Ansvarlig fakultet**

Fakultet for anvendt økologi, landbruksfag og bioteknologi

# 2BIO033 Methods in Cell and Reproductive biotechnology

Emnekode: 2BIO033

Studiepoeng: 10 credits

## Semester

Høst

## Språk

English

## Krav til forkunnskaper

Prerequisites: None

## Læringsutbytte

### Learning outcomes

Upon successful completion of the course, the student will have achieved the following learning outcomes:

#### *Knowledge:*

The student

- has thorough knowledge in scientific theory
- has advanced knowledge about relevant techniques in cell and reproductive biotechnologies
- has knowledge that can be applied in the industry and in further scientific education

#### *Skills:*

The student

- can understand and use relevant scientific literature
- can perform the following advanced laboratory techniques: cell cultivation, immunocytochemistry, fluorescence microscopy, gel electrophoresis and immunoblotting, Computer Assisted Sperm Analyses (CASA) and flow cytometry
- can work separately and in a team
- can write laboratory reports scientifically

#### *General competence:*

The student

- has thorough knowledge in cell and reproductive biotechnology, the application thereof in industry, veterinary and human medicine, and in science
- can apply his/hers knowledge and skills for planning and performing trials for a master thesis
- has understanding of Research and Development (R&D) questions and the economic implications thereof in the industry
- has thorough skills and knowledge for working in the industry

## **Innhold**

### **Content**

The course comprises two main parts:

- a lecture-based part providing an overview of special subjects in cell and reproductive biotechnologies
- three laboratory courses: Lab course 1 in basic laboratory techniques, and Lab course 2 and 3 with focus on cell culturing and analysis of sperm traits, respectively.

## **Arbeids- og undervisningsformer**

### **Organization and Methods of Instruction**

- lectures: Introductory lectures are given to provide an overview of the main themes in the course
- in-class group activities
- laboratory experiments: The students will conduct a series of relevant basic and specialized laboratory tasks
- laboratory report: Results from the specialized laboratory experiments are to be described and discussed in a scientific laboratory report. Comments on each report will be given once by the responsible teacher before the finale due date
- all relevant course information and scientific articles in the syllabus will be posted on Fronter, and the students will also hand in the laboratory reports using Fronter

## **Obligatoriske krav som må være godkjent før eksamen kan avlegges**

### **Requirements necessary to take the exam**

- attendance at 100 % of the lectures designated "compulsory" on the lecture schedule; 80 % attendance at all other scheduled lectures
- attendance at 100 % of the exercises comprising the 3 laboratory courses
- a written two-hour individual test from Lab course 1 must be passed

## **Eksamen**

### **Assessment**

- two written individual laboratory reports from Lab 2 and 3 counts 30% of the final grade
- an individual oral exam counts 70% of the final grade

Both exams must be passed to receive a final grade.

The exam will be evaluated by letter grade, A-F, where E is the lowest passing grade.

### **Ansvarlig fakultet**

Fakultet for anvendt økologi, landbruksfag og bioteknologi

## 2BIO034 Methods in Molecular Biology

Emnekode: 2BIO034

Studiepoeng: 10 credits

### Semester

Vår

### Språk

English

### Krav til forkunnskaper

Prerequisites: BSc level courses in Molecular Biology and Biochemistry (may be taken concurrently)

### Læringsutbytte

#### Learning outcomes

Upon successful completion of the course, the student will have achieved the following learning outcomes:

#### *Knowledge:*

The student

- understands the principles of central methods of the following research approaches employed in molecular biology:
  - genomics
  - functional genomics
  - transcriptomics
  - proteomics
- understands the strengths and weaknesses of each method related to their successful application in biotechnological research
- understands how the different research approaches can complement one another to address questions and/or challenges in applied biotechnology and basic biology

### ***Skills:***

The student

- has attained hands-on laboratory experience working with material and methods in two or more of the following:
  - genomics
  - functional genomics
  - transcriptomics
  - proteomics
- has attained experience in writing a report, in the format of a scientific manuscript, describing the results of an interconnected set of laboratory exercises

### ***General competence:***

The student

- has gained experience working in a team setting during preparation and execution of laboratory exercises
- has gained experience presenting course subjects, both theoretical and practical, both orally and in written form, both individually and in a team setting

## **Innhold**

### **Content**

Theoretical coverage of central methods employed in genomics, functional genomics, transcriptomics and proteomics research, and practical introduction to two or more of such methods in the laboratory

## **Arbeids- og undervisningsformer**

### **Organization and Methods of Instruction**

- lectures
- reading assignments
- laboratory exercises
- group presentations

## **Obligatoriske krav som må være godkjent før eksamen kan avlegges**

### **Requirements necessary to take the exam**

- individual report from laboratory exercises
- attendance at 100 % of the laboratory exercises (the entire duration of each)
- attendance at 80 % of the lectures

## **Eksamen**

### **Assessment**

- an individual four-hour written exam

The exam will be evaluated by letter grade, A-F, where E is the lowest passing grade

### **Ansvarlig fakultet**

Fakultet for anvendt økologi, landbruksfag og bioteknologi

# 2BIO035 Bioprocess Technology

Emnekode: 2BIO035

Studiepoeng: 5 credits

## Semester

Vår

## Språk

English

## Krav til forkunnskaper

Prerequisites: None

## Læringsutbytte

### Learning outcomes

Upon successful completion of the course, the student will have achieved the following learning outcomes:

#### *Knowledge:*

The student

- has thorough knowledge of the underlying principles of main bioprocess unit operations like fermentation, downstream processing
- has thorough knowledge about genetic engineering for recombinant protein expression and production from various cell systems
- has advanced knowledge about factorial experimental set up (Design of Experiments)

#### *Skills:*

The student

- understands how lab scale methods transform into large scale, and how main unit operations in downstream processing (centrifugation, filtration, and chromatography) function
- has advanced understanding of design of expression vector systems for protein production
- can perform experimental procedures for recovery and purification of a protein and evaluate the outcome

### ***General competence:***

The student

- understands how and why bioprocessing is employed to increase value of the feed stream
- has deeper knowledge of the main workflow and logic behind bioprocessing both in lab and industrial scale, and able to identify unit operations
- can analyze how genetic engineering is used to harness cell systems for protein production

## **Innhold**

### **Content**

- production of biologicals in the bioprocess/ biopharmaceutical industry
- fermentation technology
- microbial and mammalian cell cultures
- genetic engineering; cloning methods, vector systems, recombinant protein production
- protein isolation and separation methods; centrifugation, solubility, chromatography and membrane separations
- process economy considerations
- structured experimental approach by Design of Experiments

## **Arbeids- og undervisningsformer**

### **Organization and Methods of Instruction**

- lectures ca. 20 hours
- lab exercise - two days
- in-class group activities

## **Obligatoriske krav som må være godkjent før eksamen kan avlegges**

### **Requirements necessary to take the exam**

- 100% attendance at the preparatory lab lecture
- 100% participation at laboratory exercise
- a minimum of 80% attendance at scheduled lectures

## **Eksamen**

### **Assessment**

- individual lab report counts 60% of final grade
- individual oral exam counts 40% of final grade

Both exams must be passed to receive a final grade

The exam will be evaluated by letter grade, A-F, where E is the lowest passing grade

### **Ansvarlig fakultet**

Fakultet for anvendt økologi, landbruksfag og bioteknologi

# 2BIO201 Master`s Degree Thesis in Experimental Biotechnology

**Emnekode: 2BIO201**

**Studiepoeng: 60 credits**

## **Semester**

Vår / Høst / Vår

## **Språk**

English

## **Krav til forkunnskaper**

Prerequisites: Satisfactory progress according to the Study plan

## **Læringsutbytte**

### **Learning outcomes**

A student having completed the course have the following learning outcomes:

#### ***Knowledge:***

The Student

- has advanced knowledge in biotechnology according to scientific standards
- has advanced knowledge and skills in biotechnological subjects to conceive and complete a piece of original research

#### ***Skills:***

The Student

- can analyze and work independently on practical and theoretical problems in the field of biotechnology

#### ***General competence:***

The Student

- can analyze relevant academic, professional and research biotechnology topics
- can apply his/her knowledge and skills in scientific projects
- can communicate independent work within the academic field of biotechnology

## Innhold

### Content

Students with experimental thesis are encouraged to include Bioprocess Engineering, Molecular Genetics, or Cell Biology in the Master's thesis.

#### *Bioprocess Engineering*

The thesis will focus in depth on a specific production or product of a biotechnological nature. The experimental work may span from describing and optimising a limited unit operation to comprising the whole process. One may also couple the thesis to gene technological or cell biological research questions. Depending on the candidate's specialisation it may also be natural to include an economical analysis (sensitivity analysis) and an assessment of the commercialisation potential. One may include an internship in a relevant enterprise or use a concrete problem from industry.

The field Bioprocess Engineering comprises the theoretical description, the optimisation and the industrial use of biochemical and biological processes. Such processes include the manufacture of products involving biological/biochemical activity that require careful conservation (biomedicines, diagnostic reagents, enzymes etc). Bioprocess engineering also includes conversion processes in which the activities of enzymes or micro-organisms is essential for production (fermentation/yeasts, enzyme reactors). By utilising selective bio-processes, a number of valuable substances can be extracted from by-products of the food industry and from refined marine raw materials.

#### *Molecular Genetics and Cell Biology*

The Master's thesis in molecular genetics and cell biology will mainly consist of an experimental research project carried out in a biotechnology laboratory. The project is to be structured in consultation with an advisor, and will, with few exceptions, be linked to a larger ongoing project, or projects in relevant companies/regional research communities. Possible research topics relevant to the thesis may be molecular genetics applied to animal or plant breeding, cell biology related to animal reproduction, molecular ecology (flora and fauna, microbial diversity), molecular genetics of development, immune cell biology, gene engineering as a phase of production in a bioprocessing strategy and gene technological methods related to biobank operations. Depending on the organism studied (e.g. bears, wolves etc), a Master's thesis in molecular ecology may be completed under co-advisement from the faculty at HUC Evenstad. The biotechnology faculty at HUC collaborates with various other research institutions, both in Norway and abroad, and students may choose a project where experiments will be performed at external facilities.

Molecular genetics and cell biology include methods and techniques used to study and analyse life at the molecular and cellular level. In these two inter-connected fields, one primarily works with cells, metabolic systems, nucleic acids, genes and genomes containing, preserving and transmitting all the information governing the constitution of molecules, cells and organisms on earth. Today molecular genetic and cell biology techniques are used in all biology-related fields. Modern pharmaceutical, biomedical and biotechnological industries all base their research on these methods which are also increasingly applied in many other areas, including reproduction biology, animal and plant breeding,

immunology, and the elucidation of floral and faunal biodiversity (as part of a sub-field called molecular ecology).

## **Arbeids- og undervisningsformer**

### **Organization and Methods of Instruction**

Written thesis based on traditional scientific methods, included literature study and laboratory experiments.

## **Obligatoriske krav som må være godkjent før eksamen kan avlegges**

### **Requirements necessary to take the exam**

A compulsory 15 minute long presentation of the thesis in the end of the third semester seminar: project theme with status and so far results.

## **Eksamen**

### **Assessment**

A single letter grade, based primarily on the individual written thesis. Grade may be subject to a minor adjustment based on the oral presentation and subsequent oral exam

The grading system is based on the letters from A-F, where E is the minimum passing grade

## **Ansvarlig fakultet**

Fakultet for anvendt økologi, landbruksfag og bioteknologi

## 2BIO043 Biotechnological Methods

Emnekode: 2BIO043

Studiepoeng: 15 credits

### Semester

Høst / Vår

### Språk

English

### Krav til forkunnskaper

Prerequisites: None

### Læringsutbytte

#### Learning outcomes

Upon successful completion of the course, the student will have achieved the following learning outcomes:

#### *Knowledge:*

The student

Cell and Reproductive Biology:

- has thorough knowledge in scientific theory
- has advanced knowledge about relevant techniques in cell and reproductive biotechnologies
- has knowledge that can be applied in the industry and in further scientific education

Molecular Biology:

- has an overview of central methods of the following research approaches employed in molecular biology: genomics, functional genomics, transcriptomics and proteomics
- understands strengths and weaknesses of selected methods related to their successful application in biotechnological research
- has good understanding of how the different research approaches can complement one another to address questions and/or challenges in applied biotechnology and basic biology

Bioprocess Technology:

- has knowledge in the underlying principles of main bioprocess unit operations like fermentation, downstream processing
- has thorough knowledge about genetic engineering for recombinant protein expression and production from various cell systems

### ***Skills:***

The student

Cell and Reproductive Biology:

- can understand and use scientific literature
- can write term papers scientifically

Molecular Biology:

- has thorough experience in writing a term paper, describing methods of one or more of the following approaches with references to concrete examples of their application in biotechnological research: genomics, functional genomics, transcriptomics, proteomics

Bioprocess Technology:

- understands how lab scale methods transform into large scale, and how main unit operations in downstream processing (centrifugation, filtration, and chromatography) function.
- has good understanding in design and important features of expression vector system for protein production

### ***General competence:***

The student

Cell and Reproductive Biology:

- has thorough knowledge in cell and reproductive biotechnology, the application thereof in industry, in veterinary and human medicine, and in science
- can apply skills in R&D questions and the economic implications thereof in the industry
- has thorough skills and knowledge for working in the industry and taking further scientific education

Molecular Biology:

- has gained experience presenting course subjects, both theoretical and practical, both orally and in written form, both individually and in a team setting

Bioprocess Technology:

- has good understanding in the role of bioprocess technology in the production of value added biologicals and biopharmaceuticals
- has thorough understanding in the main workflow and logic behind bioprocessing both in lab and industrial scale, identifying unit operations and how bioprocessing is employed to increase value of the feed stream
- has thorough knowledge of how genetic engineering is used to harness cell systems for protein production

## **Innhold**

### **Content**

Methods in Cell and Reproductive Biology comprises:

- a lecture-based part providing an overview of special subjects in cell and reproductive biotechnologies
- one term paper describing selected methods and application thereof
- this course will initially discuss examples of biotechnological methods using antibodies and fluorochromes for study of cell biology. This includes theory behind the methods and application thereof. In addition, the spermatogenesis, sperm physiology, sperm traits analyses, fertilization process in the female and assisted reproductive technologies will be covered and discussed

Methods in Molecular Biology comprises:

Introductory, theoretical coverage of central methods employed in:

- genomics
- functional genomics
- transcriptomics
- proteomics

Methods in Bioprocess Technology comprises:

- production of biologicals in the bioprocess/ biopharmaceutical industry
- fermentation technology
- microbial and mammalian cell cultures
- genetic engineering; cloning methods, vector systems, recombinant protein production
- strategies for protein isolation and separation
- process economy considerations

## **Arbeids- og undervisningsformer**

### **Organization and Methods of Instruction**

Cell and Reproductive Biology:

- lectures: Introductory lectures are given to provide an overview of the main themes in the course
- in-class group activities
- term paper: A given topic on relevant techniques and application thereof will be discussed by the student
- Fronter: All relevant course information and scientific articles in the syllabus will be posted on Fronter. In addition, the students will hand in the term paper using Fronter

#### Molecular Biology:

- lectures
- reading assignments
- group presentations

#### Bioprocess Technology:

- lectures
- in-class group activities

## **Obligatoriske krav som må være godkjent før eksamen kan avlegges**

### **Requirements necessary to take the exam**

- attendance at 100 % of the designated "compulsory" on the lecture Schedule in Reproductive Biology
- 80 % attendance at all other scheduled lectures
- a written individual term paper from each of the three main subject areas (Cell and Reproductive Biology, Molecular Biology, Bioprocess Technology) must be passed

## **Eksamen**

### **Assessment**

- an individual oral exam in Cell and Reproductive Biology, Counts 40 % of the final grade (Autumn semester)
- an individual two-hour written exam in Molecular Biology, Counts 40 % of the final grade (Spring semester)
- an individual one-hour written exam in Bioprocess Technology, Counts 20 % of the final grade (Spring semester)

All exams must be passed to receive a final grade.

The exam will be evaluated by letter grade, A-F, where E is the lowest passing grade.

## **Ansvarlig fakultet**

Fakultet for anvendt økologi, landbruksfag og bioteknologi

## 2BIO063 Bioeconomy and Biobusiness II

Emnekode: 2BIO063

Studiepoeng: 10 credits

### Semester

Høst / Vår

### Språk

English

### Krav til forkunnskaper

Prerequisites: None

### Læringsutbytte

#### Learning outcomes

Upon successful completion of the course, the student will have achieved the following learning outcomes:

#### *Knowledge:*

The student

- has advanced knowledge and high motivation for innovation and entrepreneurial activities in general, and within the biotechnology sector in particular
- has thorough knowledge of successful bio-companies in Norway and abroad, and can explain why these companies have succeeded

#### *Skills:*

The student

- can use relevant methods to develop and write a viable business plan for a venture. This includes preparing a financial plan and identifying appropriate sources of capital
- can carry out and effectively communicate a good business idea and other relevant topics to key stakeholders of the start-up company

#### *General competence:*

The student

- has advanced competence in evaluating the business idea, putting together an entrepreneurial

team, attracting investors or other funding bodies and scaling the company

## Innhold

### Content

Central topics:

#### *Bio-entrepreneurship:*

- Different types of entrepreneurs and start-up companies
- Skills and competences needed to succeed as an entrepreneur in general and as a bioentrepreneur in particular
- Lean entrepreneurship
- Knowing critical success factors of new companies and being able to analyze and describe successful bio-companies and their entrepreneurs

#### *Finance:*

- Funding mechanisms for new ventures
- Cost-of-capital
- Preparing for meetings with investors or other funding bodies
- Exit strategies (Intellectual Property Owners (IPO) and industrial sale)

#### *Business Communications:*

- The language of business
- Stakeholder mapping and communication strategies, including relevant channels
- Story-telling in business

## Arbeids- og undervisningsformer

### Organization and Methods of Instruction

The course is delivered as weekly lectures combined with case studies. There will also be guest lectures given by founders and business leaders in companies in the region. Students are expected to participate in class discussions.

## Obligatoriske krav som må være godkjent før eksamen kan avlegges

### Requirements necessary to take the exam

- 2-3 individual business case assignments during the course
- a minimum of 80% presence in scheduled classes

## Eksamen

### **Assessment**

- a week-long individual home exam based on a business case and with questions related to material taught in the lectures. This exam-paper is to be defended by an individual oral examination.

The exam will be evaluated by letter grade, A-F, where E is the lowest passing grade.

### **Ansvarlig fakultet**

Fakultet for anvendt økologi, landbruksfag og bioteknologi

## 2BIO064 Methods in biobusiness

Emnekode: 2BIO064

Studiepoeng: 5 credits

### Semester

Høst

### Språk

English

### Krav til forkunnskaper

Prerequisites: 2BIO052-Bioeconomy and Biobusiness I and the requirements necessary to take the exam in 2BIO063-Bioeconomy and Biobusiness II

### Læringsutbytte

#### Learning outcomes:

Upon successful completion of the course, the student will have achieved the following learning outcomes:

#### *Knowledge:*

The Student

- has thorough knowledge in different methods that is used for research and evaluation in biobusiness
- can analyse the difference between qualitative and quantitative analysis, and different methods to collect data (online/personal surveys, interviews, shadowing etc.)

#### *Skills:*

The Student

- can select relevant methods for his/hers master thesis
- can discuss processes and consequences of using the different methods
- is able to design experiments including select appropriate methods and respondent inclusion criteria
- can calculate the number of necessary datapoints to obtain statistic significance in the sampling plan

#### *General competence:*

## The Student

- can select and use relevant methods for biobusiness analysis, and to participate in business plan preparation and strategy discussions
- can calculate the number of necessary datapoints to obtain statistic significance in the sampling plan
- can analyse and present data using relevant Methods and software

## Innhold

### Content:

This course provides an introduction to the steps of the research process and examines some of the concepts and techniques of management research that support decision making (including methods for presenting and analyzing data). The differences between qualitative and quantitative research methodologies are considered together with an overview of grounded theory. There will also be considerable emphasis on survey research. The course is structured so that students will learn how to create a research proposal and how to design, conduct, and evaluate research studies. The course is highly relevant for conducting a commercial master thesis and for future work within biobusiness.

### Methods for biobusiness analysis:

- How to find out if there is a market for a new product or service
- How to evaluate the customers true opinion about our products and services
- How to set up a hypothesis and test this in business lab Experiments to get reliable answers

## Arbeids- og undervisningsformer

### Organization and Methods of Instruction

The course is delivered as weekly lectures combined with case studies. Students are expected to participate in class discussions.

## Obligatoriske krav som må være godkjent før eksamen kan avlegges

### Requirements necessary to take the exam

- two business case assignments during the semester
- minimum of 80% presence in scheduled classes

## Eksamen

### Assessment

- individual oral exam

The grading system is based on the letters from A-F, where E is the minimum passing grade

### **Ansvarlig fakultet**

Fakultet for anvendt økologi, landbruksfag og bioteknologi

## 2BIO065 Entrepreneurship

Emnekode: 2BIO065

Studiepoeng: 15 credits

### Semester

Høst

### Språk

English

### Krav til forkunnskaper

Prerequisites: 2BIO052-Bioeconomy and Biobusiness I and the requirements necessary to take the exam in 2BIO063-Bioeconomy and Biobusiness II

### Læringsutbytte

#### Learning outcomes:

Upon successful completion of the course, the student will have achieved the following learning outcomes:

#### *Knowledge:*

The Student

- has advanced knowledge of entrepreneurship and will have insight in what it takes to build a new business

#### *Skills:*

The Student

- can plan how to go from a business idea to a business plan
- can use right timing to get the optimal people to present the business to get funding of the company

#### *General competence:*

The Student

- can plan how to set up a novel business and start a company

## **Innhold**

### **Content:**

This course will cover all topics related to starting a new business. The course is built on extensive international research in this field. To become an entrepreneur follows the same rules around the world, and is relevant for students who want to set up their own company in their home country. The course is meant to be practical training and the students will sit in with a start-up company in the incubator. In addition, there will be visits to companies and guest lectures in addition to the ordinary teaching. The student will write a business case assignment with a company, and learn how to work in an entrepreneurial team.

## **Arbeids- og undervisningsformer**

### **Organization and Methods of Instruction**

The course is delivered as weekly lectures combined with case studies, sit in with a start-up company in the incubator and visits to companies. Students are expected to participate in class discussions and in business discussions in the the companies.

## **Obligatoriske krav som må være godkjent før eksamen kan avlegges**

### **Requirements necessary to take the exam**

- business case assignment, of at least 30 pages, with the incubator start-up company
- minimum of 80% presence in scheduled classes

## **Eksamen**

### **Assessment**

- individual oral exam

The grading system is based on the letters from A-F, where E is the minimum passing grade

## **Ansvarlig fakultet**

Fakultet for anvendt økologi, landbruksfag og bioteknologi

## 2BIO066 Development of bioproducts and services

Emnekode: 2BIO066

Studiepoeng: 10 credits

### Semester

Vår

### Språk

English

### Krav til forkunnskaper

Prerequisites: 2BIO052-Bioeconomy and Biobusiness I and 2BIO063-Bioeconomy and Biobusiness II

### Læringsutbytte

#### Learning outcomes:

Upon successful completion of the course, the student will have achieved the following learning outcomes:

#### *Knowledge:*

The Student

- has advanced knowledge with how to take innovative ideas
- has thorough knowlegde in “design thinking” for product and service development

#### *Skills:*

The Student

- understands the extra requirements that comes with developing products and services in the area of biotechnology
- is able to run innovation processes for companies
- can realize innovative ideas to sellable products and services

#### *General competence:*

The Student

- can use methods to lead innovation processes from idea to product and services

## **Innhold**

### **Content:**

In other course we discuss innovation and how to build a business, while in this course we will focus on practical work how to realize an innovative idea. We will teach in methods for innovation management like “design thinking”, and we will let the students get insight into industrial design, fast prototyping, testing of products and services. Special emphasis will be on what it takes to develop a biobusiness product and service, and what the differences are to other business areas.

Biotechnology and biobusiness requires knowledge on how to conduct product development in a very structured way to avoid bringing to market products that fail and/or cause unwanted damage to people, animals and environment. Biological understanding has to be combined with technological skills and training to be able to succeed in the market. This course will train the students in how to manage the innovation process to secure to meet the customer needs and at the same time ensure safety and sustainability.

## **Arbeids- og undervisningsformer**

### **Organization and Methods of Instruction**

The course is delivered as weekly lectures combined with case studies. Students are expected to participate in class discussions. There will be guest lecturers from Companies.

## **Obligatoriske krav som må være godkjent før eksamen kan avlegges**

### **Requirements necessary to take the exam**

- one or two product or service development case assignment(s) of approximately total 20 pages
- minimum of 80% presence in scheduled classes

## **Eksamen**

### **Assessment**

- individual oral exam

The grading system is based on the letters from A-F, where E is the minimum passing grade

## **Ansvarlig fakultet**

Fakultet for anvendt økologi, landbruksfag og bioteknologi

# 2BIO203 Master`s Degree Thesis in Commercial Biotechnology

**Emnekode: 2BIO203**

**Studiepoeng: 30 credits**

## **Semester**

Høst / Vår

## **Språk**

English

## **Krav til forkunnskaper**

Prerequisites: 2BIO052- Bioeconomy and Biobusiness I, 2BIO063-Bioeconomy and Biobusiness II and 2BIO064-Methods in Biobusiness. Satisfactory progress according to the Study plan.

## **Læringsutbytte**

### **Learning outcomes**

A student having completed the course have the following learning outcomes:

#### ***Knowledge:***

The Student

- has advanced knowledge in biotechnology and biobusiness according to scientific standards
- has advanced knowledge in biotechnological and biobusiness subjects to conceive and complete a piece of original research

#### ***Skills:***

The Student

- can analyze and work independently on practical and theoretical problems in the field of biotechnological biobusiness

#### ***General competence:***

The Student

- can analyze relevant academic, professional and research biotechnology and biobusiness topics
- can apply his/her knowledge and skills in commercial projects

- can communicate independent work within the academic field of biotechnology and biobusiness

## **Innhold**

### **Content**

The objective of a specialisation in the commercialisation of biotechnology is to produce students with an academic and technical background in biotechnology and bioeconomy who are also well trained in evaluating the commercial potential for applying this knowledge. The study programme is designed to meet the expressed demand in industry for people with a strong background in biotechnology who also have expertise from other areas related to the commercial application of this knowledge, such as business administration, complementing Research and Development (R&D) strategies, innovation, business plan development, legislation, regulation and IPR. Students enrolled in this specialisation develop skills and expertise required for the development of different types of enterprises in the biotechnology sector.

The Master's thesis in the Commercialisation of Biotechnology may be based on an assessment of a selected enterprise's current status with respect to R&D and commercialisation. These may be fully established enterprises already marketing finished products, or newly started enterprises ready to design a complete strategy from development to commercialisation. The thesis can, among other things, involve the evaluation of business concepts, product ideas, IPR and marketing strategies, with the goal of establishing a new company, or expanding production in an existing one. A project of this kind usually goes through several phases from idea to profitable operation. The Master's thesis in Commercialisation of Biotechnology may therefore consist of one or more of the following elements:

- developing a business plan based on commercialisation of an existing product idea arising from biotechnological research
- developing/examining protective IPR strategies for a certain given product
- developing a marketing plan for bioproducts or services
- developing a business strategy or do market evaluation

The thesis may be completed as part of an internship at the enterprise in question, or at a company with a profile related to the proposed business concept. The Heidner business cluster harbours many biotechnology companies and organisations where a Master's thesis of this kind is most relevant. Many of these companies are located in the inland of Norway and the cluster centre is in Hamar.

## **Arbeids- og undervisningsformer**

### **Organization and Methods of Instruction**

Written thesis based on traditional scientific methods, included literature study, hypothesis testing using commercial experiments.

## **Obligatoriske krav som må være godkjent før eksamen kan avlegges**

### **Requirements necessary to take the exam**

A compulsory whole seminar attendance and 15 minute long presentation of the thesis in the beginning of the fourth semester seminar: project theme with status and so far results.

## **Eksamen**

### **Assessment**

A single letter grade, based primarily on the individual written thesis. Grade may be subject to a minor adjustment based on the oral presentation and subsequent oral exam

The grading system is based on the letters from A-F, where E is the minimum passing grade

### **Ansvarlig fakultet**

Fakultet for anvendt økologi, landbruksfag og bioteknologi