

# STUDY REGULATION for **Subject Module in Bioprocess Science**

35 ECTS

Version: 2

Valid per 1 september 2021

**ROSKILDE UNIVERSITY**



The provisions in this subject module description are issued pursuant to the rules in the bachelor's study regulation to which the student is registered.

The subject module description will become effective on 1 September 2021 and shall apply to all students. For students admitted before 1 September 2021, see the transition rules, if any, at the end of the document.

**1. About the programme**

- 1.1 The Programme's objective and competence profile - academic and professional skills
- 1.2 Languages
- 1.3 Admission requirements
- 1.4 ECTS rating and duration
- 1.5 Main subject area affiliation
- 1.6 Board of Studies and Corps of External Examiners

**2. Course of the programme**

- 2.1 Programme elements
- 2.2 Recommended academic qualifications

**3. Transitional rules**

- 3.1 Transitional rules

**4. Approval**

- 4.1 Approved by the Board of Studies
- 4.2 Approved by Rector

# 1. About the programme

## 1.1 The Programme's objective and competence profile - academic and professional skills

The objective of the subject module is to strengthen knowledge and understanding, skills and competences gained in the basic courses and projects, in order for the student to:

- gain knowledge of the disciplines, main traditions and subject areas of the selected subject module,
- be able to use the most important theories and methods of the subject module,
- understand the role of the selected subject module in the bachelor's programme's main subject area and can reflect on it,
- be able to justify and select relevant solution and analysis models

The objective of the subject module in Subject Module in Bioprocess Science is:

To provide the student with:

- Academic competencies to, independently and in collaboration with others, identify, describe, define and resolve research questions and complex problems within the subject area of biological process science by applying relevant theories and methods
- Knowledge of fundamental theories and methods within bioprocess science
- Deeper and exemplary insight into the subject areas of biology and biotechnology that particularly relate to bioprocess science, including relevant knowledge, theories and methods from chemistry, biochemistry, micro- and molecular biology, environmental biology and medicinal biology
- Experience in and exemplary insight into how the subject may be used in scientific, epistemic and societal contexts

The purpose of the subject module in Bioprocess Science is for the student to acquire basic knowledge and practical skills in the subject areas of bioprocess science.

With reference to the University Programme Order section 3, the subject module will provide the student with knowledge and understanding, skills and competences within:

Knowledge and understanding:

- Knowledge and understanding of key subject areas within biological process science and production methods including insights into medicinal-, industrial-, aquaculture- and agriculture biological production processes
- Knowledge and understanding of main organism types for bioproduction, regulating factors controlling production and key experimental methods in bioprocess science
- Insights into key production principles in different areas of biological production
- Knowledge and understanding of fundamental bioprocess science theories and their use, including the application of such theories in solving practical, application-oriented problems
- Knowledge and understanding of the societal and theoretical aspects of bioprocess science including insights into sustainable biological production

Skills:

- Skills in identifying and applying relevant bioprocess science theories and methods to address both basic science research questions and application-oriented problems within biological production
- Ability to select relevant organisms, model systems and purification methods to optimize biological production
- Skills in generating, analysing and presenting empirical data
- Skills in conducting systematic literature search for topics related to bioprocess science, and ability to read, select the relevant literature, and apply this literature in English

- Skills in communicating the acquired knowledge, both orally and in writing, accurately and scientifically relevant within the academic requirements and norms of the subject

Competences:

- Competence to recognize, describe, define and analyse basic scientific and application-oriented problems by means of the subject's theories and methods, independently and in cooperation with others
- Competence to design and conduct experiments and other studies in the field of bioprocess science, and to analyse, interpret and evaluate scientific findings within bioprocess science in the light of the methods applied
- Competence to identify and explain differences and similarities among main areas of bioprocess science (i.e., medicinal, industrial, aquaculture and agriculture biological production processes)
- Competence to reflect on how knowledge and understanding of bioprocess science contribute to and are challenged by societal and technological development
- Competence to organise and manage a project within internal and external frameworks and deadlines

## **1.2 Languages**

The subject module is offered in English.

The examination language is identical to the teaching language.

## **1.3 Admission requirements**

The admission requirements can be found on the university website.

## **1.4 ECTS rating and duration**

The subject module has a total ECTS rating of 35 ECTS.

## **1.5 Main subject area affiliation**

The subject module belongs under the main subject area of Natural Sciences.

## **1.6 Board of Studies and Corps of External Examiners**

The subject module belongs under the Board of Studies for Natural Sciences

The subject module is affiliated with the Corps of External Examiners for Biology.

# **2. Course of the programme**

## **2.1 Programme elements**

- Subject Module Project in Bioprocess Science (15 ECTS)
- Subject Module Course 1: An Introduction to Bioprocess Science (5 ECTS)
- Subject Module Course 2: Applied Bioprocess Science I (5 ECTS)
- Subject Module Course 3: Applied Bioprocess Science II (5 ECTS)
- Subject Module Course 4a: General Molecular Biology (5 ECTS)
- Subject Module Course 4b: Field Course and Data Analysis (5 ECTS)

**Please note regarding Subject Module Course 4:**

Subject Module Course 4 depends on the student's other subject module:

If the student is enrolled in the Subject Module in Environmental Biology, Mathematics or Chemistry, the student must take the following course: Subject Module Course 4a: General Molecular Biology (5 ECTS)

If the student is enrolled in the Subject Module in Computer Science or Molecular Biology, the student must take the following course: Subject Module Course 4b: Field Course and Data Analysis (5 ECTS)

Title	Subject Module Project in Bioprocess Science
Amended	01.09.21
Teaching language	English
Type of activity	Project
ECTS-rating	15 ECTS
Learning outcomes and assessment criteria	<ul style="list-style-type: none"> <li>• Knowledge and understanding of concepts, theories and methods in Bioprocess science relevant to the work on the selected research question</li> <li>• Knowledge and understanding of the principles of the practical and theoretical methods used in the project work</li> <li>• Proficiency in conducting relevant literature search in relevant databases and summarizing the scientific background literature for the selected research question</li> <li>• Proficiency in selecting and using relevant methods and analyses</li> <li>• Proficiency in preparing satisfactory and accurate directions for the practical (i.e., experimental or investigative) work</li> <li>• Proficiency in communicating and discussing the project and acquired knowledge orally and in writing in an accurate and scientifically relevant way in accordance with within the academic requirements and norms</li> <li>• Competence to identify a relevant research questions within a topic in Bioprocess science, and to formulate a testable hypothesis, and design and conduct experiments/studies to test these hypotheses</li> <li>• Competence to account for the main principles of the methods applied and of other methods which may be used in connection with the research question</li> <li>• Competence to analyse and interpret the data obtained in relation to simple models (of understanding) and data from literature</li> <li>• Competence to organize and manage a project process within internal and external frameworks and deadlines</li> </ul>
Overall content	The project should address a relevant research question within the subject area bioprocess science and must include the analysis of empirical data (obtained from own experiments, surveys and/or from the

	<p>literature). The project should also include a recaption of the literature which forms the basis for the subject/problem of the project. Emphasis is placed on knowledge of the methods used (weaknesses and strengths) and on the processing and interpretation of the compiled data. Programming, simulations, virtual parts or other can be a part of the submitted project. The project work is concluded with the preparation of a written project report, and if relevant other products such as programmes, simulations, virtual parts and other products.</p>
Teaching and working methods	<p>The project is prepared in groups of 2-6 students under the supervision of a supervisor, see, the relevant bachelor curriculum</p>
Type of exam	<div> <p><b>Type of exam</b></p> <p>Oral group exam for the participants in the project.</p> <p>The starting point for the oral exam is the project report and any supplementary material. The exam includes individual presentations within one of the topics selected by the examiner, which will be communicated to the students no later than 3 working days prior to the exam. Each individual presentation including questions may last up to 7 minutes. A dialogue between the student(s) and the assessors about the project, will be conducted after the individual presentation(s).</p> <p>There may be posed questions related to the subject area of the project report.</p> <p>The assessment is individual and is based on the project report, any additional material and the student's oral performance.</p> <p>Permitted group size: 2-6 students.</p> <p>The character limits of the project report are:  For 2 students: 24,000-180,000 characters, including spaces.  For 3 students: 24,000-192,000 characters, including spaces.  For 4 students: 24,000-192,000 characters, including spaces.  For 5 students: 24,000-204,000 characters, including spaces.  For 6 students: 24,000-204,000 characters, including spaces.  The character limits include the cover, table of contents, summary, bibliography, figures and other illustrations, but exclude any appendices.</p> <p>Time allowed for exam including time used for assessment is for:  2 students: 60 minutes.  3 students: 75 minutes.  4 students: 90 minutes.  5 students: 105 minutes.  6 students: 120 minutes.</p> <p>Spelling and communication skills in the project report are part</p> </div>

	<p>of the assessment.</p> <p>Permitted support and preparation materials at the oral exam: All</p> <p>Assessment: 7-point grading scale. Moderation: External examiner.</p>
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<b>Title</b>	<b>Subject Module Course 1: An Introduction to Bioprocess Science</b>
Amended	01.09.21
Teaching language	English
Type of activity	Mandatory course
ECTS-rating	5 ECTS
Learning outcomes and assessment criteria	<ul style="list-style-type: none"> <li>• Knowledge and understanding of fundamental bioprocess science theories and their use</li> <li>• Knowledge and understanding of aquaculture processes (marine and freshwater) e.g., micro- and macroalgae, crustacean and fish production</li> <li>• Insights into agricultural processes, e.g., selection in animal and plant production to increase productivity, develop resistant crops and production of high-value products</li> <li>• Knowledge and understanding of industrial processes e.g., fermentation, use of microorganisms and cells in chemical and enzyme production, including insights in the use of GMOs</li> <li>• Knowledge and understanding of medicinal processes e.g., biobased drug development and cell-based therapy</li> <li>• Knowledge of key organism types and production principles, and insight into how these may be used for sustainable production</li> <li>• Proficiency in using acquired knowledge for identifying conditions and processes with major influence on production of valuable substances and material</li> <li>• Proficiency in carrying out simulations of selected bioprocess reactions and production based on the acquired knowledge</li> <li>• Competence to identify and explain differences and similarities among main areas of Bioprocess science, the student should obtain an interdisciplinary approach to biological production,</li> <li>• Competence to explain the main principles in key bioprocess science methods</li> </ul>



	<ul style="list-style-type: none"> <li>• Competence to evaluate whether and to what degree changes in selected bioprocesses may change the end product</li> <li>• Competence to reflect on how knowledge and understanding of Bioprocess science contribute to and are challenged by societal and technological development</li> </ul>
Overall content	Theoretical course in fundamental areas of bioprocessing. During the course the most important production methods of bioprocessing within the four main areas of bioprocess science are introduced and covered. The student will gain understanding of the most essential organisms and how these are used in bioprocessing and production. The course also clarifies the relations and differences between the four main areas of bioprocessing.
Teaching and working methods	The course consists of a series of lectures, simulations and exercises.
Type of exam	<p><b>Type of exam</b> Individual written invigilated exam in a topic(s) given by the lecturer.</p> <p>The duration of the exam is 3 hours.</p> <p>Permitted support and preparation materials for the exam: All.</p> <p>Assessment: 7-point grading scale. Moderation: Internal co-assessor.</p>

Title	Subject Module Course 2: Applied Bioprocess Science I
Amended	01.09.21
Teaching language	English
Type of activity	Mandatory course
ECTS-rating	5 ECTS
Learning outcomes and assessment criteria	<ul style="list-style-type: none"> <li>• Knowledge and understanding of aquaculture and agriculture production processes, including regulating factors for key organisms used in bioprocess science, and the regulation and optimization in production of biological resources</li> <li>• Knowledge and understanding of fundamental bioprocess science theories and their application in solving practical production problems</li> </ul>

	<ul style="list-style-type: none"> <li>• Knowledge and understanding of key experimental methods and their use in bioprocess science</li> <li>• Knowledge and understanding of energy- and nutrient cycles relevant for the production of organisms in biological production</li> <li>• Proficiency in evaluating and explaining key processes in a production-cycle</li> <li>• Proficiency in designing systems for simple biological production by bacteria, eukaryotic cell-lines, yeast and algae cells.</li> <li>• Proficiency in applying relevant theories, methods, data analysis, and in presenting empirical data in a concise and academically relevant way.</li> <li>• Competences to work with complex issues related to biological production</li> <li>• Competences to design and perform experiments and/or investigations within bioprocess science, and to analyse, interpret and assess scientific results in the light of the methods employed</li> <li>• Competence to engage different disciplinary approaches in solving scientific or application-oriented problems in biological production</li> </ul>
Overall content	<p>The course consists of both theoretical and practical elements. The course is case based and the objective of the course is to let the student immerse in the cases which mainly focus on production techniques and approaches in the production of biomass and valuable biologically derived substances.</p>
Teaching and working methods	<p>The course works with a number of cases and each case encompass theoretical and hands-on teaching. The theoretical component entails a presentation of the case and relevant theory and may consist of external lectures and student presentations. The hands-on teaching may consists of workshops, laboratory exercises, computer simulations, company visits and can both be individual or group work. During the course the student chooses different topics that form a portfolio. The student is appointed an advisor among the course lecturers for introduction to the portfolio format and for feedback.</p>
Type of exam	<div> <p><b>Type of exam</b> Individual portfolio consisting of written products and other types of products.</p> <p>The portfolio consists of 10 products, of which some developed during the course. The products are an analysis of empirical data, a reporting from a systematic literature study, reflexions on research ethics and an individual reflection memo. The preparation of the products may be subject to time limits.</p> </div>

	<p>The total character limit of portfolio incl. the written products is maximum 24,000 characters, including spaces. The character limits include the cover, table of contents, bibliography, figures and other illustrations, but exclude any appendices.</p> <p>The portfolio's specific products and the (if relevant) recommended size (character limits) for the individual products are made public on study.ruc.dk before the course begins.</p> <p>The entire portfolio must be handed in at the same time (uploaded to eksamen.ruc.dk). Handing in the portfolio or parts of the portfolio to the supervisor for feedback, cannot replace the upload to eksamen.ruc.dk. The submission deadline will be announced on study.ruc.dk before the course begins.</p> <p>The assessment is individual and based on the entire portfolio.</p> <p>Assessment: Pass/Fail. Moderation: Internal co-assessor.</p>
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<b>Title</b>	<b>Subject Module Course 3: Applied Bioprocess Science II</b>
Amended	01.09.21
Teaching language	English
Type of activity	Mandatory course
ECTS-rating	5 ECTS
Learning outcomes and assessment criteria	<ul style="list-style-type: none"> <li>• Knowledge and understanding of the usage of different organisms in bioprocess science, and of key organisms in production, and of how they may be used for sustainable biological production</li> <li>• Knowledge and understanding of industrial processes, e.g., fermentation, use of microorganisms and cells, including genetically modified organisms, in production of biological products such as pharmaceuticals and enzymes</li> <li>• Knowledge and understanding of methods for gene editing, construction of genetically modified organisms for drug development, and of methods for purification and validation of biological products</li> <li>• Proficiency in evaluating and selecting organisms that are optimal for biological production of specified medical or industrial products</li> </ul>

	<ul style="list-style-type: none"> <li>• Proficiency in preparing adequate and concise prescriptions for practical, experimental and investigative work</li> <li>• Proficiency in using relevant methods including extraction and analysis of valuable substances such as lipids, proteins, pigments.</li> <li>• Proficiency in analysing and communicating empirical scientific data within bioprocess science</li> <li>• Competences to design and perform experiments and/or investigations within bioprocess science, and to analyse, interpret and assess scientific results in the light of the methods employed</li> <li>• Competences in solving complex problems related to extraction of valuable substances from different model organisms, in collaboration with other students.</li> <li>• Competence to predict how and to what degree changes in selected bioprocesses may affect the final product</li> </ul>
Overall content	Theoretical and practical course to understand the processes of extracting valuable substances from organisms used in bioprocess science.
Teaching and working methods	During the course the students works with several cases. Each case encompass theoretical and hands-on teaching. The theoretical component entails a presentation of the case and relevant theory and consist of external lectures and student presentations. The hands-on teaching may consist of workshops, laboratory exercises, computer simulations, company visits and can both be individual or group work. Each case is concluded with a written case report on the basis of the empirical data found during the work with the cases.
Prerequisites for participation in the exam	The student must submit up to 5 case reports in order to attend the exam. The exact number of case reports is determined by the responsible course lecturer.
Type of exam	<p><b>Type of exam</b></p> <p>Individual oral exam with a starting point in a written case assignment possibly done by a group.</p> <p>The student begins the exam with a short presentation based on the written product and an exam question. The student pick the exam question (by drawing lots) no later than three weekdays before the oral exam</p> <p>There may be posed questions in any part of the curriculum. Permitted group size: 2-4 students.</p> <p>The character limits of the written product are:</p> <p>For 1 student: maximum 12,000 characters, including spaces. For 2 students: maximum 12,000 characters, including spaces.</p>

	<p>For 3 students: maximum 12,000 characters, including spaces. For 4 students: maximum 12,000 characters, including spaces.</p> <p>The character limits include the cover, table of contents, bibliography, figures and other illustrations, but exclude any appendices.</p> <p>Time allowed for exam including time used for assessment: 30 minutes.</p> <p>The assessment is an overall assessment of the written product(s) and the subsequent oral examination.. The assessment is individual and based on the student's individual performance.</p> <p>Permitted support and preparation materials for the oral exam: All.</p> <p>Assessment: 7-point grading scale. Moderation: Internal co-assessor.</p>
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<b>Title</b>	<b>Subject Module Course 4a: General Molecular Biology</b>
Amended	01.09.21
Teaching language	English
Type of activity	Mandatory course
ECTS-rating	5 ECTS
Learning outcomes and assessment criteria	<ul style="list-style-type: none"> <li>• Knowledge and understanding of the central dogma of molecular biology</li> <li>• Knowledge and understanding of fundamental molecular biological terms, concepts and methods</li> <li>• Knowledge and understanding of the organisation of the genetic material of prokaryotic and eukaryotic cells</li> <li>• Knowledge and understanding of the structure and biosynthesis of the cell macromolecules DNA, RNA and protein</li> <li>• Knowledge and understanding of basic mechanisms in the regulation of gene expression</li> <li>• Skills in explaining the biochemical mechanisms involved in replication, transcription, RNA processing and translation</li> <li>• Skills in analysing and processing data from simple molecular biological experiments</li> </ul>

	<ul style="list-style-type: none"> <li>• Skills in analysing DNA sequences for signals of gene expressions</li> <li>• Skills in explaining the principles behind selected methods of characterising macromolecules</li> <li>• Skills in presenting/communicating the acquired molecular biological knowledge in an accurate and professionally competent manner</li> <li>• The competence to conduct theoretical and experimental project work based on a biological research question using the theories and methods of molecular biology</li> <li>• The competence to solve simple practical and/or experimental problems of molecular biological nature</li> </ul>
Overall content	An introduction to the synthesis and function of the information-bearing biopolymers of cells, DNA, RNA and protein, as well as the organisation, function and expression of genes, and basic methods of characterising protein and DNA.
Teaching and working methods	Lectures with discussion of topics and time for problem solving and exercise task.
Type of exam	<p><b>Type of exam</b> Individual written invigilated examination in assignment provided by the lecturer.</p> <p>The invigilated examination is divided into two parts, both of which are provided at the start of the examination. The first part must be handed in after 25 minutes.</p> <p>An overall mark will be provided.</p> <p>Permitted support and preparation materials for the first 25 minutes of the invigilated examination: Computer with internet access and non-programmable pocket calculator. Permitted support and preparation materials for the rest of the invigilated examination: Computer without internet access during the examination, non-programmable pocket calculator, course materials and own notes.</p> <p>The invigilated examination lasts three hours.</p> <p>Assessment: 7-point grading scale.</p> <p>Moderation: Internal co-assessor</p>

<b>Title</b>	<b>Subject Module Course 4b: Field course &amp; Data Analysis</b>
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Amended	01.09.21
Teaching language	English
Type of activity	<p>Mandatory course</p> <p>Course consisting of three parts: · I. Aquatic field biology. · II. Terrestrial field biology. · III. Data analysis.</p>
ECTS-rating	5 ECTS
Learning outcomes and assessment criteria	<ul style="list-style-type: none"> <li>• Parts I and II (Aquatic and Terrestrial Field Biology):</li> <li>• Knowledge and understanding of Danish natural habitats such as streams, lakes, fjords, forests, meadows, salt meadows, bogs, etc.</li> <li>• Knowledge of the flora and fauna found in these sites</li> <li>• Knowledge of the physical and chemical settings characterising these sites and knowledge of how these settings affect the composition of flora and fauna.</li> <li>• Proficiency in measuring simple physicochemical parameters used to describe the conditions of the site</li> <li>• Proficiency in collecting flora and fauna qualitatively and quantitatively using the correct methods</li> <li>• Proficiency in identifying and classifying the collected flora and fauna by using national and international identification literature.</li> <li>• Competence to identify and assess the composition of the flora and fauna on a given site in relation to the physical and chemical framework characterising the site in question and in that connection assess whether the site in question is significantly disrupted by human activity.</li> <li>• Part III (Data analysis):</li> <li>• Knowledge of how to design an experiment and/or study with the necessary replication, use of controls, etc.</li> <li>• Knowledge and understanding of how you select and use proper statistical methods to analyse compiled data.</li> <li>• Proficiency in designing and conducting experiments and studies in a scientifically correct manner.</li> <li>• Proficiency in selecting proper statistical methods and applying these to analyse compiled data and in assessing the weaknesses and strengths of these methods</li> <li>• Proficiency in reading and understanding scientific literature which presents results from statistical analysis.</li> <li>• Competence to design and conduct experiments or studies, including subsequent data processing in a scientifically sound manner</li> </ul>
Overall content	

	<p>Parts I and II. Aquatic and terrestrial Field Biology: Practical field courses dealing with Danish flora, fauna and natural habitats. Each course lasts for 6 days and is held as a live-in course at a field station. The courses include field trips to a number of aquatic (rivers, lakes and fjords) and terrestrial (forest, meadow, bog) sites from which flora and fauna are collected and identified. The presence of plants and animals is discussed in relation to the organismal requirements to the environment. Both courses end with a presentation seminar. Part III. Data analysis: Theoretical/practical course in applied statistics and experimental design. The course reviews methods and theories needed for the design of experiments and surveys. The course will further present a number of the statistical methods most commonly used for the analysing analysis of biological data (e.g. such as descriptive analysis, comparison of two and more mean values, analysis of relationships (correlation and regression statistics etc.). The course includes a series of lectures and calculus exercises.</p>
Teaching and working methods	It is recommended that the student has completed subject module course 1, An introduction to Ecosystems, before taking this course.
Prerequisites for participation in the exam	Prerequisite for participating in the re-examination for parts I and II: The student must meet the requirement of 80% satisfactory active attendance. If the requirement of satisfactory active attendance is not met, the student must sign up for the course the next time it is offered.
Type of exam	<p><b>Type of exam</b></p> <p>The course consists of three parts. Students must pass all three parts.</p> <p>The first two parts (Aquatic and Terrestrial Field Courses) are passed through active, regular and satisfactory attendance, defined as follows:</p> <p>The student must participate in the activities associated with the teaching (for example, workshops, seminars, field trips, process study groups, working conferences, supervisory groups, feedback sessions).</p> <p>Regular attendance is defined as:</p> <ul style="list-style-type: none"> <li>-The student must have a satisfactory attendance of at least 80% of the experimental/practical parts of the course and must have prepared the relevant analyses and interpretations of data.</li> </ul> <p>Satisfactory active participation is defined as:</p> <ul style="list-style-type: none"> <li>-The student must attend two oral presentations (one for each of the two parts).</li> </ul> <p>The third part (Data Analysis) is passed by taking an individual written, invigilated examination in an assignment given by the lecturer.</p> <p>The duration of the invigilated examination is 2 hours.</p> <p>Permitted support and preparation materials for the invigilated</p>



	<p>examination: Textbook, notes, calculator (any model) and personal computer (without internet access).</p> <p>If a student does not pass one or more of the parts of the course, the student must take the examination for that part or parts.</p> <p>Assessment: Pass/Fail</p>
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## 2.2 Recommended academic qualifications

The subject module builds on the competences acquired in the basic courses and projects of the Bachelor's programme in natural science. Students who do not possess these or equivalent competences must expect additional study in order to be able to complete the subject module in the required time. Prior to commencing this subject module, the student is recommended to acquire knowledge, skills and competences equivalent to that obtained through courses in: Cell Biology and Organic Chemistry.

## 3. Transitional rules

### 3.1 Transitional rules

## 4. Approval

### 4.1 Approved by the Board of Studies

Approved by the Board of Studies for Natural Sciences on 29.01.21.

The chairperson for external examiners is informed about amendments before the study regulation comes into force.

### 4.2 Approved by Rector

Approved by Rector Hanne Leth Andersen on 3 February 2021.