



# Programme-specific Section of the Curriculum for the MSc Programme in Biosolutions at the Faculty of Science, University of Copenhagen 2024

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## 1 Title, affiliation and language

A shared section that applies to all BSc, part-time MSc and MSc Programmes at the Faculty of Science is linked to this programme-specific curriculum.

### 1.1 Title

The MSc Programme in Biosolutions leads to a Master of Science (MSc) in Biosolutions with the Danish title: *Cand.scient. (candidatus/candidata scientiarum) i biologiske løsninger*.

### 1.2 Affiliation

The programme is affiliated with the Study Board for the Biological Area and the students can both elect, and be elected, to this study board.

### 1.3 Corps of external examiners

The following corps of external examiners is used for the central parts of the MSc Programme:

- Corps of External Examiners for Agricultural Science (*jordbrugsvidenskab*).

### 1.4 Language

The language of this MSc Programme is English.

## 2 Academic profile

### 2.1 Purpose

The purpose of the study programme in Biosolutions is to educate candidates for the increasing and urgent need for sustainable biologically based solutions and products worldwide.

The objective of the programme is to offer the students a cross disciplinary approach and to build on knowledge of biological systems. Here, how to adapt biological organisms and processes in an industrial context, and to provide an understanding of sustainable solutions and technologies for future biobased products.

The candidates will gain knowledge of microorganisms and others production host, linking to the processes related to production, enabling them to implement the best and most sustainable solutions. In addition, the candidates will acquire knowledge of raw material, enzymes and how this can be combined for the final products. The programme also includes insight in circular production including how to use side streams, and how to optimize quality and sustainability in processes and products.

The candidates acquire digital skills to implement sensor use, how to process data to optimize processes and to choose the material based on these analyses. The programme fosters an innovative mindset and business understanding, and this is supported and developed through collaboration with the industry during the education.

### 2.2 General programme profile

Candidates in Biosolutions acquire strong interdisciplinary skills and can bridge the gap between science and industry, ensuring growth in the field of biosolutions.

The aim of the programme is:

To educate candidates with expertise in developing and adapting biological organisms and processes for sustainable production of bio-based products in the industry. To provide students with a solid understanding of sustainable solutions and technologies for future bio-based products.

- Optimization of quality and sustainability in processes, technologies, and products

- Analyze and apply sensor data for quality control, process optimization, and new product design.
- To have insight in legislation, regulation of production processes and products. Including QA and QC, as well as more general skills like project management and patenting

The education spans across disciplines and is based on knowledge of biological systems and how to develop and adapt biological organisms and processes in an industrial context.

The students will through close collaboration with companies be trained in developing an innovative mindset and business understanding, that will enable them to contribute to innovation. There will be praxis integration, where students can work on company cases and projects in collaboration with businesses during their courses.

Applied biotechnology to provide solutions using biological knowledge and process understanding is the key subject area of the programme.

### **2.3 General structure of the programme**

The MSc Programme is set at 120 ECTS.

There are no defined specialisations in this programme.

### **2.4 Career opportunities**

The MSc Programme in Biosolutions qualifies students to become professionals within industrial production of bio-based products and processes for production purposes, refinement and utilization of biological raw materials and enzymes for processing and optimizing bio-based products. Following business functions and/or areas such as:

- Product development in biosolutions industry
- Quality control and development
- Engineering and process design
- Process development and optimization – automatization and robot technology
- Regulatory processes
- Analysis and product optimization
- Advisors and consultants in governmental agencies
- A PhD programme.

## **3 Description of competence profiles**

Students following the MSc Programme acquire the knowledge, skills and competences listed below. Students will also acquire other qualifications through elective subject elements and other study activities.

### **3.1 Competence profile**

Graduates holding an MSc in Biosolutions have acquired the following:

#### Knowledge about:

- Relevant production organisms, enzymes, and biological raw materials for various production methods based on the latest research.
- The theory behind the methods and processes such as biorefining, fermentation, and synthetic biology.
- Product quality, including knowledge of quality control (QA and QC).

- Business practices, including awareness of markets and their product requirements.
- Legislation, regulations, and necessary permits from authorities for production and products.
- Intellectual property rights related to research and business development.
- Insight in existing programming languages, digital platforms, and software.

#### Skills in/to:

- Assessing and selecting research-based knowledge, methods, and tools to create new products and optimized processes within the field of biosolutions.
- Selecting and optimizing the use of various organisms for production purposes.
- Designing new processes based on knowledge of raw materials, enzymatic processes, by-products, and product quality requirements.
- Applying independent knowledge of data analysis to formulate new solution models in research and production contexts.
- Analyzing and understanding the relationship between research and production conditions.
- Critically evaluating the field's theories to choose relevant production organisms, enzymes, and raw materials for various production methods.
- Assessing and utilizing different production processes, including defining the problem, data collection, and selecting experimental and empirical methods.
- Evaluating and using analysis and modeling tools in data science and having insight into new technologies.
- Interpreting, managing, and understanding connections in large datasets and integrating this with biological knowledge to formulate new solution models.
- Analyzing, interpreting, and critically assessing tests of new solutions and their results.
- Assessing and selecting scientific methods to develop production holistically, incorporating circular processes and sustainability.
- Identifying, analyzing, and discussing how new solutions can impact the connections in production processes.
- Identifying, assessing, and explaining the market requirements and regulations that new solutions/products in the biosolutions field must adhere to.
- Clearly communicating issues and potential applications within the core area of biosolutions.

#### Competences in/to:

- Handling large amounts of data from production and biological omics.
- Creating an overview of the connections in production processes, including knowledge of by-product utilization.
- Independently planning and organizing development work.
- Reflecting on how to optimize and develop sustainable production based on societal needs.
- Assessing the need for seeking new knowledge to plan and initiate relevant new initiatives.
- Work effectively in teams as well as independently, apply project management in cross-disciplinary environments.

## 4 Admission requirements

### 4.1 Bachelor's degrees that automatically fulfil the academic requirements

Applicants with one of the following Bachelor's degrees automatically fulfil the academic requirements for admission to the MSc Programme in Biosolutions:

- Biotechnology (*bioteknologi*) from University of Copenhagen
- Food Science (*fødevarer og ernæring*) from University of Copenhagen
- Biotechnology from Aalborg University
- Bachelor's degree in Engineering (Life Science Engineering) with a specialisation in Biotechnology from Technical University of Denmark
- Bachelor's degree in Engineering (Biotechnology) (*civilingeniør*) from Aarhus University
- Bachelor's degree in Engineering (Chemical Engineering and Biotechnology) (*civilingeniør*) from the University of Southern Denmark
- Bachelor of Engineering in Biotechnology (*diplomingeniør*) from Aarhus University
- Bachelor of Engineering in Biotechnology (*diplomingeniør*) from University College Absalon.

### 4.2 Other Bachelor's degrees

Applicants with a Bachelor's degree, Professional Bachelor's degree or equivalent from Danish or international universities other than those listed in 4.1 are qualified for admission to the MSc Programme in Biosolutions if the programme includes the following:

- 7.5 ECTS within a biological system (microorganisms or plants)
- 15 ECTS within biochemistry/organic chemistry
- 15 ECTS within biotechnology methods
- 15 ECTS within statistics/mathematics

In total the applicant must have a minimum of 30 ECTS derived from courses with experimental laboratory exercises.

### 4.3 Other applicants

The Faculty may also admit applicants who, after an individual academic assessment, are assessed to possess educational qualifications equivalent to those required in Subclauses 4.1-2.

### 4.4 Language requirements

Applicants must as a minimum document English language qualifications comparable to a Danish upper secondary school English B level or English proficiency corresponding to the tests and scores required. Accepted tests and required minimum scores are published online at [www.science.ku.dk](http://www.science.ku.dk).

### 4.5 Supplementary subject elements

The qualifications of an applicant to the MSc programme are assessed exclusively on the basis of the qualifying Bachelor's degree. Supplementary subject elements passed between the completion of the Bachelor's programme and the admission to the MSc programme cannot be included in the overall assessment.

However, subject elements passed before the completion of the Bachelor's programme may be included in the overall assessment. This includes subject elements completed as continuing education as well as subject elements completed as part of a former higher education programme. A maximum of 30 ECTS supplementary subject elements can be included in the overall assessment.

Subject elements passed before completing the Bachelor's programme which are to form part of the MSc programme to which the student has a legal right of admission (§15-courses) cannot be included in the overall assessment.

## 5 Prioritisation of applicants

There is no Bachelor's Programme with reserved access for this programme.

If the number of qualified applicants to the programme exceeds the number of places available, applicants will be prioritised according to the following criteria:

- Total number of ECTS in relevant courses\*
- Grades in relevant courses\*

\*Relevant courses include courses in biological system (microorganisms or plants), biochemistry/organic chemistry, biotechnology methods and statistics/mathematics.

## 6 Structure of the programme

The compulsory subject elements, restricted elective subject elements and the thesis constitute the central parts of the programme (Section 30 of the Ministerial Order on Bachelor and Master's Programmes (Candidatus) at Universities).

### 6.1 Programme components

The programme is set at 120 ECTS and consists of the following:

- Compulsory subject elements, 45 ECTS.
- Restricted elective subject elements, 15 ECTS
- Elective subject elements, 15 ECTS
- Thesis, 45 ECTS.

#### 6.1.1 Compulsory subject elements

The following subject element is to be covered (30 ECTS):			
Course Code	Course Title	Block	ECTS
NPLK24003U	Biosolutions in Industrial Application	Block 1	7.5 ECTS
NFOK24000U	Bioprocess Engineering	Block 1	7.5 ECTS
NFOK24001U	Data Handling and Analyses	Block 2	7.5 ECTS
NPLK24001U	Biological Production Hosts: Bench to Pilot Scale	Block 2	7.5 ECTS
NPLK24002U	Fermentation at Scale	Block 3	7.5 ECTS
NFOK24002U	Downstream Processing	Block 3	7.5 ECTS

### 6.1.2 Restricted elective subject elements

30 ECTS are to be covered as subject elements from the following list:			
Course Code	Course Title	Block	ECTS
	Quality Assessment and Legislation – From Idea to Product*	Block 1	7.5 ECTS
	Applying Biosolutions*	Block 1	7.5 ECTS
	Introduction to Project Management*	Block 1	7.5 ECTS
NIGK24002U	Advanced Production Systems	Block 4	7.5 ECTS
NFOK24003U	Sustainable Processing and Production Systems	Block 4	7.5 ECTS
	Project outside course scope	Block 1-5	7.5 ECTS 15 ECTS
	Project in Practice	Block 1-5	15 ECTS
	Thesis Preparation Project	Block 1-5	7.5 ECTS

\*The course is not offered in the academic year 2024/25.

### 6.1.3 Elective subject elements

15 ECTS are to be covered as elective subject elements.

- All subject elements at MSc level may be included as elective subject elements in the MSc Programme.
- BSc subject elements corresponding to 7.5 ECTS may be included in the MSc Programme.
- Projects. See 6.1.4 Projects.

### 6.1.4 Projects

Projects outside the course scope, projects in practice and thesis preparation projects may not exceed 22.5 ECTS of the programme.

- Projects outside the course scope may be included in the elective and/or restricted elective section of the programme with up to 15 ECTS. Projects outside the course scope may be written as a combination of the restricted elective and elective section of the programme. The regulations are described in Appendix 5 to the shared section of the curriculum.
- Projects in practice may be included in the elective and/or restricted elective section of the programme with 15 ECTS. Projects in practice may be written as a combination of the restricted elective and elective section of the programme. Projects in practice may not exceed 15 ECTS in total of the programme. The regulations are described in Appendix 4 to the shared section of the curriculum.
- Thesis preparation projects may be included in the elective and/or restricted elective section of the programme with up to 15 ECTS. The regulations are described in Appendix 6 to the shared section of the curriculum.

### 6.1.5 Thesis

The MSc Programme in Biosolutions includes a thesis corresponding to 45 ECTS, as described in Appendix 2 to the shared curriculum. The thesis must be written within the academic scope of the programme.

### **6.1.6 Academic Mobility**

The curriculum makes it possible to follow subject elements outside the Faculty of Science.

The academic mobility for the MSc Programme in Biosolutions is placed in block 3+4 of the 1<sup>st</sup> year.

Academic mobility requires that the student follows the rules and regulations regarding pre-approval and credit transfer.

In addition, the student has the possibility to arrange similar academic mobility in other parts of the programme.

## **7 Exemptions**

In exceptional circumstances, the study board may grant exemptions from the rules in the curriculum specified solely by the Faculty of Science.

## **8 Commencement etc.**

### **8.1 Validity**

This subject specific section of the curriculum applies to all students enrolled in the programme – see however Appendix 2.

### **8.2 Transfer**

Students enrolled on previous curricula may be transferred to the new one as per the applicable transfer regulations or according to an individual credit transfer by the study board.

### **8.3 Amendment**

The curriculum may be amended once a year so that any changes come into effect at the beginning of the academic year. Amendments must be proposed by the study board and approved by the Dean.

Notification about amendments that tighten the admission requirements for the programme will be published online at [www.science.ku.dk](http://www.science.ku.dk) one year before they come into effect.

If amendments are made to this curriculum, an interim arrangement may be added if necessary to allow students to complete their MSc Programme according to the amended curriculum.



## Appendix 1 The recommended academic progression

The table illustrates the recommended academic progression. The student is allowed to plan an alternative progression within the applicable rules.

**Table – MSc Programme in Biosolutions**

	Block 1	Block 2	Block 3	Block 4
1st year	Biosolution in Industrial Application	Data Handling and Analysis	Fermentation at Scale	Elective
	Bioprocess Engineering	Biological Production Hosts: Bench to Pilot Scale	Downstream Processing and Refining	Elective
2nd year	Restricted elective	Thesis		
	Restricted elective			

## Appendix 2 Interim arrangements

The Shared Section of the BSc and MSc Curricula for Study Programmes applies to all students.

There are currently no interim arrangements to this curriculum.

## Appendix 3 Description of objectives for the thesis

After completing the thesis, the student should have:

### Knowledge about:

- How to identify scientific problems within the study programme's subject area.
- How to summarize a suitable combination of methodologies to support and develop biobased solutions.
- How to discuss theories and models on the basis of an organized value system and with a high degree of independence.
- How to optimize processes to develop biobased solutions to be used in industry.

### Skills in/to:

- Apply and critically evaluate theories and methods including their applicability and limitations.
- Assess the extent to which the production and interpretation of findings/material depend on the chosen methods.
- Discuss academic issues arising from the thesis and how this is correlated to developing new processes and products.
- Draw conclusions in a clear and academic manner in relation to the problem formulation.
- Discuss and communicate the academic and social significance, in terms of sustainability.
- Improve and innovate bioprocessing of biobased products.

If the thesis includes experimental content and own data production, the student will also be able to:

- Substantiate the idea of conducting experimenting in order to shed light on the topic as described in the problem formulation.
- Process data through a choice of academic analysis methods and present findings objectively and in a concise manner.
- Assess the credibility of own findings based on relevant data processing.

### Competences in/to:

- Initiate and perform academic work in a research context.
- Solve complex problems and carry out development assignments in a professional context.
- Evaluate the needed quality assessment and legal requirements.