The Faculty of Engineering and Science
Board of Studies for Chemistry, Environmental
Engineering and Biotechnology

AALBORG UNIVERSITY
DENMARK

Curriculum for the Master's Program in Sustainable Biotechnology

Aalborg University
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Campus Copenhagen

Preface

Pursuant to Act 367 of March 25, 2013 on Universities (the University Act) with subsequent changes, the following curriculum for the Master's program in Sustainable Biotechnology is stipulated. The program also follows the Framework Provisions and the Examination Policies and Procedures for the Faculties of Engineering, Science and Medicine.

Aalborg University, 2014

Niels T. Eriksen

Chairman of Study Board

Approved by the Dean, 2014

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Chapter 1: Legal basis of the Study Regulations

1.1 Basis in ministerial orders

The Master's program in Sustainable Biotechnology is organised in accordance with the Ministry of Science, Innovation and Higher Education's Order no. 1520 of December 16, 2013 on Bachelor's and Master's Programs at Universities (the Ministerial Order of the Study Programs) and Ministerial Order no. 1518 of December 16, 2013 on University Examinations (the Examination Order) with subsequent changes. Further reference is made to Ministerial Order no. 1488 of December 16, 2013 (the Admission Order) and Ministerial Order no. 250 of March 15, 2007 (the Grading Scale Order) with subsequent changes.

1.2 The Faculties of Engineering, Science and Medicine affiliation

The Master's program falls under the Faculty of Engineering and Science, Aalborg University.

1.3 The Study Board affiliation

The Master's programme fall under the Study Board for Biotechnology, Chemical and Environmental Engineering.

Chapter 2: Admission, degree/title, program duration and competence profile

2.1 Admission

Admission to the Master's programme in Sustainable Biotechnology requires a Bachelor's degree in Chemistry, Environmental Engineering or Biotechnology, or the like.

Students with another Bachelor's degree, upon application to the Board of Studies, will be admitted after a specific academic assessment if the applicant is deemed to have comparable educational prerequisites. The University can stipulate requirements concerning conducting additional exams prior to the start of study.

2.2 Degree/title in Danish, Latin and English

Successful completion of the Master's programme entitles the student to use the title Cand.polyt. i Bæredygtig bioteknologi. The corresponding English title is: Master of Science (MSc) in Engineering (Sustainable Biotechnology).

2.3 The program's specification in ECTS

The Master's program is a 2-year, research based, full-time study program. The program is set to120 ECTS.

2.4 The program's competence profile

The following competence profile will appear on the diploma:

A Candidatus graduate has the following competency profile:
A Candidatus graduate has competencies that have been acquired via a course of study that has taken place in a research environment.
A Candidatus graduate is qualified for employment on the labour market on the basis of his or her academic discipline as well as for further research (PhD programmes). A Candidatus graduate has, compared to a Bachelor, developed his or her academic knowledge and independence so as to be able to apply scientific theory and method on an independent basis within both an academic and a professional context.

Description of qualifications:

Individuals who attain degrees at this level

Knowledge

- Are to have knowledge within sustainable biotechnology to use state of the art biotechnological techniques and methods for process development and exploitation of renewable sustainable resources as replacements for fossil resources and mitigation of green-house gases.
- Are to be able, on a scientific basis, to understand and reflect over the knowledge associated with general biotechnology, microbiological production, sustainability, biomass conversion processes, biorefineries, production of biomaterials, biochemicals, and bioactive compounds, and be able to identify scientific problems related to these areas.

Skills

- Are to master the scientific methods and tools of the above-mentioned areas and master the general skills that are tied to work within sustainable biotechnology.
- Are to be able to evaluate and select among the scientific theories, methods, tools and general skills of sustainable biotechnology, and set up, on a scientific basis, new analysis and

solution models
- Are to be able to communicate research based knowledge and discuss professional and scientific problems with both peers and non-specialists.

Competences

- Are to be able to develop and design biotechnological processes and biorefineries for the sustainable conversion of biomass into valuable products.
- Are to be able to independently initiate and carry out discipline specific and cross-disciplinary cooperation and to assume professional responsibility within the area of sustainable biotechnology.
- Are to be able to independently take responsibility for their own professional development and specialization.

Chapter 3: Content of the Study Program

An overview of the Master's programme is outlined in table 1.

Semester	Module	ECTS	Grading	Assessment
1.	Advanced Microbiological Production	15	7-point scale	Internal
	Biorefinery Principles	5	7-point scale	Internal
	Sustainability	5	7-point scale	Internal
	Biological Production Processes	5	7-point scale	Internal
2.	Design of Biomass Conversion Processes	15	7-point scale	Internal
	Microbiological Discovery	5	7-point scale	Internal
	Advanced Kinetics and Modelling of Bioprocesses	5	7-point scale	Internal
	Anaerobic and Fungal Biotechnology	5	7-point scale	Internal
3. a	First part of long Master's Thesis Individual semester* External studies	30		
3. b**	Sustainable Biorefinery Concepts	20	7-point scale	External
	Production of Biomaterials and Biochemicals, and Bioactive Compounds	5	7-point scale	Internal
	Optional courses	5		
4. a	Second part of long Master's Thesis	30	7-point scale	External
4. b	Master's Thesis	30	7-point scale	External

*cf. Framework Provisions section 9.4.1, students are given several choices of composing an individual planned semester, including extending the master's thesis to up to 60 ECTS.

** This semester is only offered if there are more than 20 students

3.1 Projects

3.1.1 The project unit on 1st semester.

Dansk titel English title	Videregående mikrobiel produktion Advanced Microbiological Production
Placement	1st semester
Prerequisites	-
Purpose	The purpose of the course is that the student work with microbiological production of new enzymes, biochemicals, food, feed, food ingredients, biomaterials, biofuels and bioactive compounds such as medicine, prebiotics and antibiotics. Also the student will work with microbial fermentation, the biochemistry behind microbial processes and the biochemical structure of different biomasses. This will take place as group work on a topic of own choice.
Learning outcomes	After the project work the student should: • Possess an understanding and overview of different biological and biochemical processes that occur in microbiological fermentation and production. • Understand plant cell walls and the structure of plant material in general • Be able to suggest relevant enzymes for processing of specific biomasses • Suggest strategies of relevance to their project to improve products yield.
Content	The students choose a project among offered project descriptions within microbiological production. The project work consists of a theoretical and an experimental part and could focus on all aspects of microbiological production from molecular biology to microbiology. Process related topics are only sparsely included. The sustainability and CO_2 balance of the production could be considered. Also the students will be offered to actively participate in laboratory exercises designed to gain basic laboratory skills within basic biochemical, molecular biological and microbiological processes, if they do not have such skills prior to the course. The format of the project is a written report. To support the project work, the students follow the course "Biological production processes".
Duration in ECTS	15
Language	English
Exam form	Internal
Assessment	Oral examination based upon a written report and the project closing
Marking	Individual marking according to the 7-point grading scale
Assessment criteria	As stated in the framework provisions

3.1.2 The project unit on 2nd semester

Dansk titel English title	Design af biomasseomsætnings-processer Design of Biomass Conversion Processes
Placement	2nd semester
Prerequisites	-
Purpose	The purpose of the course is to present the different sub-processes that are used in the conversion of biomass to biofuels/biochemicals/materials and feed/food components and combine them in order to design a complete production process.
Learning outcomes	After the project work the student should be able to: • Quantify the content of relevant components and compounds in a specific biomass. • Design and perform experiments to evaluate the potential of a biomass for the production of specific products: o Test and evaluate pre-treatment techniques o Perform bench-scale fermentations o Suggest separation/purification techniques/processes for intermediate and end products • Design the most appropriate process scheme (batch or continues) including pre-treatment process, fermentation, purification, and down-stream processing for common types of biomass. • Develop the complete flow-diagram of a production process and close the mass and energy balances. • Make a rough equipment sizing and costing. • Perform a preliminary capital and operating cost estimation.
Content	The project may be partially performed either as lab exercises, where biomass is characterized, pre-treated, fermented and the products are purified or as theoretical exercise using already available laboratory results. Intermediate and end products are analyzed, and mass and energy balances are established. The gained results are compared with literature data and the format of the report is a scientific article.
Duration in ECTS	15 ECTS
Language	English
Exam form	Internal
Assessment	Oral examination based upon a written report
Marking	Individual marking according to the 7-point grading scale
Assessment criteria	As stated in the framework provisions

3.1.3 Project unit on 3rd semester

Dansk titel English title	Bæredygtige bioraffinaderikoncepter Sustainable Biorefinery Concepts
Placement	3rd semester
Prerequisites	-
Purpose	During the course the students design a sustainable biorefinery concept based on biological and physical – chemical processes to convert biomass to biofuels/biochemicals/materials and feed/food components.
Learning outcomes	After the project work the student should be able to: • Describe a biorefinery concept for sustainable production of biofuels, chemicals, materials and/or feed from a defined biomass. • Set up a mass and energy balance of a complete biorefinery consisting of at least 3 separate biotechnological processes and physical-chemical pre- and post-treatment. • Describe the technical composition of a corresponding biorefinery plant based upon unit processes focussing on kinetics of the separate biotechnological processes. • Set up a process flow-scheme of the biorefinery concept. • Apply sustainability criteria in the development of biorefinery concepts and estimate the environmental impact and safety issues of these concepts. • Estimate the investment costs and the operational costs of a biorefinery concept.
Content	Based upon the knowledge on microbial conversion processes and physical-chemical pre- and post-treatment processes, and the principles for combination in a biorefinery acquired through preceding semesters , a sustainable biorefinery concept is developed consisting of at least 3 biotechnological processes and physical-chemical pre- and post-treatment processes. The project report is made as a business plan of a new biorefinery plant optimizing sustainability, cost- and energy-efficiency for the production of biofuels, chemicals, materials, and/or feed from biomass. The report should contain mass, energy and greenhouse gas balances, process schemes, estimations of investment needs and operational costs, evaluation of sustainability, and a description of optimization strategies for the final biorefinery concept.
Duration in ECTS	20 ECTS
Language	English
Exam form	External
Assessment	Oral examination based upon a written report and the project closing
Marking	Individual marking according to the 7-point grading scale
Assessment criteria	As stated in the framework provisions

3.1.4 Master project

Dansk titel English title	Kandidatspeciale Master's Thesis
Placement	4th semester (short project) or 3rd and 4th semester (long project)
Prerequisites	-
Purpose	To leave the student the opportunity for an independent scientific engagement and the planning and performance of a long-term scientific project.
Learning outcomes	After the project work the student should be able to: • Plan, perform and report a comprehensive individual research project within agreed time. • Carry out technical development and research and solve complicated technical problems using scientific methods. • Critically evaluate and compare the results of a project in relation to existing knowledge and well-recognized theories of the scientific area. • Include societal, economical, environmental and safety related considerations in the evaluation of the feasibility of a project. • Provide a well-balanced and efficient written and oral presentation of the results and conclusions gained in a scientific project.
Content	Generally, the projects are related to ongoing research activities at Section for Sustainable Biotechnology. Projects can also be carried out in full or partial collaboration with companies or other Danish or foreign research institutions. The project will normally consist of theoretical and experimental parts and has to be presented as a report or as a scientific article manuscript generally performed by one student and according to common scientific principles. It is a university policy to make the results achieved during the project accessible to relevant recipient groups during publication in a scientific journal or in a popular format.
Duration in ECTS	30-60 ECTS
Language	English
Exam form	External
Assessment	Oral examination based upon a written report and the project closing
Marking	Individual marking according to the 7-point grading scale
Assessment criteria	As stated in the framework provisions

3.2 Courses

3.2.1 Biological production processes

Dansk titel **English title**	**Biologiske produktionsprocesser** **Biological Production Processes**
Placement	1st semester
Prerequisites	-
Aim	To give knowledge to the students about the biological and biochemical processes that are involved in the utilization and conversion of biomass to valuable products: Food, feed, fuels, chemicals, and materials. The course will also include molecular biology, bioenergetics and basic bio-reactor principles and give the students the necessary knowledge to independently plan and perform a project in microbiological production.
Learning outcomes	After the course the student should be able to: • Use molecular biology tools for genetic engineering • Suggest and apply usable enzymes for biomass degradation • Differentiate between main groups of microorganisms and their use in a production process. • Combine energetics and microbial growth • Compare the most important types of bioreactors and suggest the optimal type for a specific production process.
Content	The course will provide the student with an overview of the biological and biochemical processes that are used for conversion of biomass to valuable products. The course focuses on fundamental biochemical, microbiological, and molecular biology concepts such as: • Enzyme technology related to biomass composition and the use of enzymes for biomass degradation. • Molecular biology tools for microbiological production and genetic engineering of microorganisms. • Thermodynamics in relation to microbial growth and product formation • Use of microorganisms for biological production processes (fungi, algae, bacteria, and archaea) The course also includes an introduction to commonly used bioreactors and structure and characteristics of biomasses used as feedstock in sustainable production processes. The course is organized in weekly lectures and theoretical and lab-exercises.
Duration in ECTS	5
Language	English
Exam form	Internal
Assessment	Written examination
Marking	Individual marking according to the 7-point grading scale
Assessment criteria	As stated in the framework provisions

3.2.2 Sustainability

Dansk titel **English title**	**Bæredygtighed** **Sustainability**
Placement	1st semester
Prerequisites	-
Purpose	The purpose of the course is to give an overview of sustainability principles and a number of principles and methods that are parts of sustainability considerations.
Learning outcomes	After the course the student should be able to: • Outline sustainability concepts related to energy, thermodynamics, nutrients, water, and greenhouse gases. • Perform sustainability estimations and simple life cycle analyses. • Relate sustainability to societal perspectives. • Analyze biotechnological processes with respect to sustainability. • Include ethical considerations in sustainability analyses. • Outline the relationships between sustainability and development and understand projections of resource and environmental issues including global and local models. • Include economic considerations in sustainability analyses.
Content	The course is arranged as 2 weekly theoretical exercises where each theme is initiated by a lecture given by staff members or by invited lecturers. The different themes (sustainability concepts; thermodynamics and sustainability; sustainability and life cycle analyses; sustainability and energy, nutrients, water, and greenhouse gases; bioethics and sustainability; economics, development, and sustainability) are treated in case studies as a basis for discussions in groups. The different themes are finally included in a poster, which is produced group wise.
Duration in ECTS	5 ECTS
Language	English
Exam form	Internal
Assessment	Oral individual examination in the poster and written examination
Marking	Individual marking according to the 7-point grading scale
Assessment criteria	As stated in the framework provisions

3.2.3 Biorefinery principles

Dansk titel English title	Bioraffinaderiprincipper Biorefinery Principles
Placement	1st semester
Prerequisites	Microbiological production; Bio-production processes
Purpose	The purpose of the course is to present these processes in lectures, calculation exercises, and discussions to impart competences to the students to construct biorefineries based upon biomass types, amounts and products.
Learning outcomes	After the course the student should be able to: • Evaluate biomasses with respect to their applicability in biorefineries and outline which qualities that are associated with applicability. • Devise a suitable biorefinery technique for the conversion of a given biomass into a specific product. • Identify and analyse the limitations by existing physical-chemical, thermochemical, and biological methods for biomass conversion. • Account for existing biorefinery concepts and technologies. • Compare different types of biorefineries with each other and oil refineries. • Outline possible technological couplings and combinations with other process industry. • Set up mass and energy balances for different biomass conversions. • Apply one or more of the general calculation models for estimation of costs and energy efficiency in the conversion of different biomasses into different products. • Evaluate the environmental consequences of biorefinery activities.
Content	The conversion of biomass into biofuels, commodities for chemical production, food, feed, biochemicals etc demands several chemical physical and biological processes, which together constitute a biorefinery. The course provides the students with a broad knowledge of the principles and processes associated to biorefineries. This includes: • Description of different types of biomasses and their compatibility with existing biorefinery concepts (lignocellulosic refineries, whole crop refineries, green refineries, sugar-based refineries, biofuel refineries, and biorefineries based upon thermochemical processes) and their product relevance (carbohydrate, lignin, protein and amino acids, fats, oils, and chemical based products and special ingredients). • Description and analysis of the different process steps (pre-treatment methods, separation techniques, treatment and purification of intermediate products, recycling of water, wastewater purification etc), which are necessary for a sustainable conversion of biomass to biofuels, chemicals, feed and bio-based materials. • Analysis and estimations of: i) biomass production and collection costs, ii) capital and running costs for the different biomass conversion steps, iii) environmental

	consequences of biorefineries.. The course consists of 2 weekly lectures and subsequent theoretical exercises.
Duration in ECTS	5 ECTS
Language	English
Exam form	Internal
Assessment	Written examination
Marking	Individual marking according to the 7-point grading scale
Assessment criteria	As stated in the framework provisions

3.2.4 Microbiological discovery

Dansk titel **English title**	**Mikrobiologisk discovery** **Microbiological Discovery**
Placement	2nd semester
Prerequisites	Microbiological production, Biological production processes
Purpose	The purpose of this course is to give a thorough introduction to screening concepts for new microorganisms with new properties, and to molecular methods to find new genes and gene products. The main focus will be on screening for enzyme producing fungi and discovery of efficient hydrolytic enzymes and other bioactive proteins.
Learning outcomes	After the course the student should be able to: • Describe different screening strategies and their benefits and limitations. • Devise and describe relevant classical screening strategies for microorganisms with specific capabilities. • Devise and describe relevant advanced molecular screening strategies for identification of specific genes or gene products.
Content	There is an increasing requirement to find new microorganisms and to identify specific capabilities in known or uncultivable microorganisms for industrial, environmental, and medical applications. The course consists of a project-based theoretical and practical part where the students collaborate in small projects supported by a weekly lecture. In the projects, the students chose and test a screening strategy and search for organisms having specific capabilities. The course focuses on: • Bacteria and fungi with different properties, e.g. aerobic/anaerobic, thermophilic/mesophilic/psychrophilic. • Classic screening strategies for bacteria and fungi with specific properties. • Molecular screening strategies for different genes and/or gene products. • Theoretical and practical introduction to relevant microbiological and molecular biological methods such as relevant media for growth of bacteria and fungi with

	specific properties, construction of genome and cDNA libraries, functional screening, metagenomics for analysis of mixed consortia and gene cloning. • Application of genomics, proteomics, and bioinformatics.
Duration in ECTS	5 ECTS
Language	English
Exam form	Internal
Assessment	Written examination
Marking	Individual marking according to the 7-point grading scale
Assessment criteria	As stated in the framework provisions

3.2.5 Anaerobic and fungal biotechnology

Dansk titel **English title**	**Anaerob og svampe-bioteknologi** **Anaerobic and Fungal Biotechnology**
Placement	2nd semester
Prerequisites	Microbial production, Bio-production processes.
Purpose	The purpose of the course is to present biotechnologically relevant anaerobic microorganisms to the students through practical exercises and to introduce and practise methods and techniques for isolation, handling, and manipulations of anaerobic microorganisms. The fungal part of the course gives the student a deeper insight into modern advanced fungal biotechnological methods and applications in industry and research.
Learning outcomes	After the course the student should be able to: • Describe important groups of anaerobic bacteria, archaea, and fungi • Compose and prepare media for the cultivation of anaerobic microorganisms. • Enrich, isolate and cultivate anaerobic microorganisms • Describe the use of fungi in research and industry with emphasis on heterologous gene technology. • Describe the use of yeasts and filamentous fungi for different biotechnological purposes. • Suggest and apply fungal biotechnological methods. • Utilize relevant genetic technological and bioinformatic methods. •
Content	In the anaerobic part of the course, one weekly lecture and lab exercise is given per week. Anaerobic microorganisms play important roles in the production of biofuels in which the greater part of the energy present in the biomass is maintained in the product. Due to the high oxygen content of the atmosphere, a huge and complex methodology has been developed to isolate, cultivate, and manipulate oxygen-sensitive anaerobic

	microorganisms and enzymes. The following topics are presented in the lectures: • Energy metabolism in anaerobes – energy optimization and redox balances. • Ecology, physiology, and phylogeny of anaerobic microorganisms with potential application in biotechnology. During the exercises all necessary techniques for isolation and cultivation of anaerobes are practised. In the fungal biotechnological part of the course 2 weekly lectures are given together with a practical exercise in bioinformatics. An excursion to Novozymes A/S is included in this part of the course. Fungi play an important role as production organisms for numerous products such as enzymes and antibiotics. By genetic modification of the fungi it is possible to optimize their protein production for different purposes including enzyme production. During the course, the molecular methods used for optimizing fungi as industrial production organisms and for heterologous gene expression in research are presented. The following topics are presented in the lectures. • The use of fungi as production organisms for enzymes and other products • Molecular tools to improve production strains by means of pathway engineering, gene disruption, and targeted gene insertion. • Theoretical and practical introduction to relevant molecular methods such as gene cloning, construction of plasmids, development/improvement of gene variants, protein engineering, fungal transformations, and identification of potential enzyme producing transformants. • The use of bioinformatics • Up-scaling from lab-scale to pilot and production plants
Duration in ECTS	5 ECTS
Language	English
Exam form	Internal
Assessment	Written examination
Marking	Individual grading based on the 7-point grading scale
Assessment criteria	As stated in the framework provisions

3.2.6 Advanced Kinetics and modelling of bioprocesses

Dansk titel **English title**	**Avanceret kinetik og modellering af bioprocesser** **Advanced Kinetics and Modelling of Bioprocesses**
Placement	2nd semester
Prerequisites	Preceeding semesters
Purpose	To provide the students a thorough knowledge of different bioreactors' structure, the associated kinetics, and modelling of the biological processes taking place in the bioreactors and familiarize them with modelling and simulation software tool(s).
Learning outcomes	After the course the student should be able to: • Estimate the kinetic parameters and choose the key process variables for the development of efficient modelling schemes. • Derive the mathematical model of a bio-process. • Apply a mathematical model on different bioreactor configurations. • Apply mathematical and kinetic models to compare different types of bioreactors. • Interpret and evaluate modelling data from bioreactors.
Content	Kinetic analyses will, together with bioreactor design, equilibrium considerations, yield, transport phenomena, phase equilibria, enzyme kinetics, and microbial growth kinetics, form the basis for case studies of different bioprocesses. In the modelling part, advanced computer software will be used for the construction of complete models of concepts that students may work with during their master projects. This will include model development, fitting of the model to experimental data and estimation of the model parameters, and model-based prediction of the production in the bioreactors. The course consists of weekly lectures and calculation exercises.
Duration in ECTS	5 ECTS
Language	English
Exam form	Internal
Assessment	The assessment and the final grading will be based on an oral examination on a mini, software-based modeling project (25% weight) and a written examination (75% weight)
Marking	Individual grading based on the 7-point grading scale
Assessment criteria	As stated in the framework provisions

3.2.7 Production of biomaterials, biochemical and bioactive compounds

Dansk titel **English title**	**Produktion af biomaterialer, biokemikalier og bioaktive forbindelser** **Production of Biomaterials, Biochemicals and Bioactive Compounds**
Placement	3rd semester
Prerequisites	Biological production processes, Microbiological discovery and Fungal and anaerobic biotechnology
Aim	The purpose of the course is to provide the student with an insight into the use of microorganisms as producers of biomaterials, biochemical and bioactive compounds and discuss possible new methods for the production of these compounds and related commodities for e.g. the relevant industry.
Learning outcomes	After the course the student should be able to: • Devise strategies to screen for microorganisms producing specific biomaterials, biochemical and bioactive compounds. • Draw up strategies to utilize microorganisms for the production of specific biomaterials, biochemical and bioactive compounds. • Suggest how to modify biochemical pathways in microorganisms. • Devise downstream processing techniques and suggest potential modifications of purified compounds based upon literature studies.
Content	Microorganisms can produce a number of environmental friendly compounds such as biomaterials, biochemical and bioactive compounds. The production of these compounds might be improved by genetic modification of the microorganisms and by screening for new microorganisms, which have the potential to produce different relevant compounds. Furthermore, most plants and algae produce an array of bioactive compounds to inhibit infections by microorganisms. Only some of these compounds and their mechanisms are known, but it is expected that such compounds and other bioactive compounds from plants and algae will play an important role as antibiotics, prebiotics, antioxidants, cytostatics etc. During the processing of biomass in biorefineries these compounds might be separated as high-value side streams and thereby contribute as an important resource for the pharmaceutical industry. Also, the bioactive compounds may be produced by microorganisms by introducing the pathways from the plant or algae. The course consists of an introduction to the field based upon the newest literature, and consists of one weekly literature discussion where the newest scientific developments within the field are presented.. The project is worked out as a scientific research paper. The course focuses on: • Microorganisms as cell factories

	• Microbial screening for production of specific biomaterials, biochemical and bioactive compounds. • Assays for specific biomaterials, biochemical and bioactive compounds • Modification of biochemical pathways by pathway engineering and the use of bioinformatics to control and increase the production of biomaterials and biochemicals.
Duration in ECTS	5 ECTS
Language	English
Exam form	Internal
Assessment	Internal evaluation based upon a written report and an oral examination
Marking	Individual grading based on the 7-point grading scale
Assessment criteria	As stated in the framework provisions

Chapter 4: Entry into force, interim provisions and revision

The curriculum is approved by the Dean of the Faculty of Engineering and Science and enters into force as of September 2014.

Students who wish to complete their studies under the previous curriculum from 2013 must conclude their education by the summer examination period 2015 at the latest, since examinations under the previous curriculum are not offered after this time.

In accordance with the Framework Provisions for the Faculty of Engineering and Science and The Faculty of Medicine at Aalborg University, the curriculum must be revised no later than 5 years after its entry into force.

Chapter 5: Other rules

5.1 3rd semester

On the 3rd semester in accordance with the framework provisions section 5.3 the students have on their own initiative the following options instead of an ordinary project.

- Documentation of the semester project through a scientific article
- Individual project preparing a scientific report or article
- Transversal studies
- Relevant internship
- Long dissertation (Master thesis) on 3rd and 4th semester on programmes experimental in nature.

The particular wishes of the students must be approved by the study board prior to semester start.

5.2 Rules for written assignments including the Master's thesis and its scope

An evaluation of the student's spelling and writing ability enters into the assessment of all written work, regardless of what language it is written in. Orthographic and grammatical correctness and stylistic proficiency are taken as a basis for the evaluation of language performance. Language performance must always enter in as an independent dimension of the total evaluation. However, no examination can be assessed as 'Pass' on the basis of language performance alone; similarly, an examination normally cannot be assessed as 'Fail' on the basis of poor language performance alone. The above applies unless other rules are stated in connection with the individual examination.

The Master's thesis must include a summary in a foreign language (English, French, Spanish or German subject to the study board's approval). If the project is written in a foreign language (English, French, Spanish or German) the summary can be written in Danish subject to the study board's approval. The summary must be at least 1 page and may be at most 2 pages (the summary is not counted in any fixed minimum and maximum page count per student). The summary enters into the evaluation of the project as a whole.

5.3 Credit transfer

Students with other program elements from other Master's programs can obtain credit/admission subject to the study board's evaluation of the individual application (meritering).

5.4 Rules for the maximum period of enrolment

The Master's programme must be completed within 4 years at the latest following enrolment, excluding leaves of absence.

5.5 Rules for examinations

The rules for examinations appear in "Examination Policies and Procedures" published on the Faculty of Engineering and Science website www.teknat.aau.dk.

5.5 Exemption

In the case of unusual circumstances, the study board can grant exemptions from those parts of the study regulations that are not fixed by law or ministerial order. Exemption regarding an examination applies to the immediate examination.