



AALBORG UNIVERSITET

# **MASTER OF SCIENCE (MSC) IN ENGINEERING (CHEMICAL ENGINEERING)**

MASTER OF SCIENCE (MSC) IN ENGINEERING  
ESBJERG

MODULES INCLUDED IN THE CURRICULUM

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# PROCESS ANALYSIS

2018/2019

## CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

### LEARNING OBJECTIVES

#### KNOWLEDGE

Students who have passed the module should be able to

- Account for which theoretical, numerical and experimental tools are available to solve the selected problem in process analysis
- Explain the physical, chemical and mathematical theory behind the selected tools

#### SKILLS

- Apply instruments, equipment, data sampling systems and instrumental chemical analysis to solve the problem
- Evaluate which kind of theory and or equipment gives the fastest and most robust answer to the questions raised
- Write a project report following the standards of the field of study, include relevant original scientific literature, use the correct terminology, and communicate the research-based foundation, problem and results of the project in writing, graphically and orally in a coherent way
- Assess and select relevant original scientific literature and current scientific methods, models and other tools used in the project and assess the problem of the project and results in relevant scientific contexts and social conditions

#### COMPETENCES

- Transfer the obtained theory and methodology to other problems involving process analysis
- Handle the planning, implementation and management of complex and unpredictable research and/or developmental tasks and take professional responsibility for implementing academic assignments and interdisciplinary collaborations
- Take responsibility for own professional development and specialization

#### TYPE OF INSTRUCTION

- Project work

#### EXTENT AND EXPECTED WORKLOAD

450 hours

## EXAM

### EXAMS

Name of exam	Process Analysis
Type of exam	Oral exam based on a project
ECTS	15
Assessment	7-point grading scale
Type of grading	Internal examination
Criteria of assessment	As stated in the Joint Programme Regulations

## FACTS ABOUT THE MODULE

Danish title	Procesanalyse
Module code	K-KT-K1-18
Module type	Project
Duration	1 semester
Semester	Autumn
ECTS	15
Language of instruction	English
Empty-place Scheme	Yes
Location of the lecture	Campus Esbjerg
Responsible for the module	<a href="#">Sergey Kucheryavskiy</a>

## ORGANISATION

Study Board	Study Board of Biotechnology, Chemistry and Environmental Engineering
Department	Department of Chemistry and Bioscience
Faculty	Faculty of Engineering and Science

# FLUID MECHANICS

2018/2019

## CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

### LEARNING OBJECTIVES

#### KNOWLEDGE

Students who have passed the module should be able to

- Explain fundamental basis for the formulation and analysis of the statics and dynamics of the flow of viscous fluids
- Account for fluid kinematics
- Explain stresses in fluids, equation of motion, constitutive models and Navier-Stokes equations
- Account for Reynolds averaging and turbulence models
- Describe turbulent and laminar boundary layers including understanding of momentum equation for boundary layers
- Explain the basic phenomena involved in multiphase flows

#### SKILLS

- Plan, design and make experiments and choose measurements methods suitable to the characteristics of the fluid
- Determine and apply appropriate experimental methods to fluid flows
- Apply appropriate analytical, semi-empirical and numerical methods for mathematical description of fluid dynamic problems
- Use multiphase flow models

#### COMPETENCES

- Independently define and analyse scientific problems within the area of fluid dynamics
- Independently be a part of professional and interdisciplinary development work within the area of fluid dynamics

#### TYPE OF INSTRUCTION

- Lectures, workshops, exercises, mini-projects and self-studies

#### EXTENT AND EXPECTED WORKLOAD

150 hours

### EXAM

#### EXAMS

Name of exam	Fluid Mechanics
Type of exam	Written or oral exam
ECTS	5
Assessment	7-point grading scale
Type of grading	Internal examination
Criteria of assessment	As stated in the Joint Programme Regulations

## FACTS ABOUT THE MODULE

Danish title	Strømningslære
Module code	K-KT-K1-7
Module type	Course
Duration	1 semester
Semester	Autumn
ECTS	5
Language of instruction	English
Empty-place Scheme	Yes
Location of the lecture	Campus Esbjerg
Responsible for the module	<a href="#">Matthias Mandø</a>

## ORGANISATION

Study Board	Study Board of Biotechnology, Chemistry and Environmental Engineering
Department	Department of Chemistry and Bioscience
Faculty	Faculty of Engineering and Science

# COLLOID AND INTERFACE SCIENCE

2018/2019

## CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

### LEARNING OBJECTIVES

#### KNOWLEDGE

Students who have passed the module should be able to

- Account for different types of colloids and their stability
- Account for adsorption at interfaces
- Account for surfactants, wettability and emulsions
- Account for different scattering techniques, X-ray methods and electron microscopy
- Account for different disciplines in which the theory of colloid and interface science are beneficial for understanding details of products or processes
- Explain the importance of size and interparticle forces that result in macroscopic properties of substances
- Explain models of colloids and interfaces that can be used for the description and understanding of different colloid systems. This involves physical equations, diagrams, drawings and images

#### SKILLS

- Apply general theory of colloid science in combination with experimental tools
- Evaluate which kinds of experimental tools that preferable can be used to enhance the physico-chemical understanding of a given process or product

#### COMPETENCES

- Select and apply models to describe different colloidal systems and interfaces

#### TYPE OF INSTRUCTION

- Lectures laboratory problems and theoretical exercises

#### EXTENT AND EXPECTED WORKLOAD

150 hours

## EXAM

### EXAMS

Name of exam	Colloid and Interface Science
Type of exam	Oral exam
ECTS	5
Assessment	7-point grading scale
Type of grading	Internal examination
Criteria of assessment	As stated in the Joint Programme Regulations

## FACTS ABOUT THE MODULE

Danish title	Kolloid- og grænsefladekemi
Module code	K-KT-K1-8
Module type	Course
Duration	1 semester
Semester	Autumn
ECTS	5
Language of instruction	English
Empty-place Scheme	Yes
Location of the lecture	Campus Esbjerg
Responsible for the module	<a href="#">Erik Gydesen Søgaard</a>

## ORGANISATION

Study Board	Study Board of Biotechnology, Chemistry and Environmental Engineering
Department	Department of Chemistry and Bioscience
Faculty	Faculty of Engineering and Science



# CHEMOMETRICS

2018/2019

## CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

### LEARNING OBJECTIVES

#### KNOWLEDGE

Students who have passed the module should be able to

- Account for general methods for multivariate data analysis (principal component analysis, multiple linear regression, principal component regression, projection on latent structures, soft independent modelling of class analogy)
- Account for methods for data preprocessing (centering, scaling, non-linear and spectroscopic preprocessing, orthogonal signal correction)
- Explain basic methods for variable selection (Selectivity ratio, VIP, interval PLS, jack-knife)
- Explain the theoretical background of these methods, their advantages and limitations as well as possible applications
- Explain how multivariate methods complement traditional statistical methods

#### SKILLS

- Explore multivariate data, find groups and trends, detect and remove outliers
- Calibrate and do proper validation of multivariate regression models, use these models for prediction
- Evaluate if data need a preprocessing and which method to apply
- Calibrate and evaluate models for data classification
- Compare different regression and classification models and find which is the best
- Use multivariate methods for analysis of real data from different applications

#### TYPE OF INSTRUCTION

- Lectures, classroom instruction and mini-projects

#### EXTENT AND EXPECTED WORKLOAD

150 hours

## EXAM

### EXAMS

Name of exam	Chemometrics
Type of exam	Written exam
ECTS	5
Assessment	Passed/Not Passed
Type of grading	Internal examination
Criteria of assessment	As stated in the Joint Programme Regulations

## FACTS ABOUT THE MODULE

Danish title	Kemometri
Module code	K-KT-K1-9
Module type	Course
Duration	1 semester
Semester	Autumn
ECTS	5
Language of instruction	English
Empty-place Scheme	Yes
Location of the lecture	Campus Esbjerg
Responsible for the module	<a href="#">Sergey Kucheryavskiy</a>

## ORGANISATION

Study Board	Study Board of Biotechnology, Chemistry and Environmental Engineering
Department	Department of Chemistry and Bioscience
Faculty	Faculty of Engineering and Science

# PROCESS MODELLING

2018/2019

## CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

### LEARNING OBJECTIVES

#### KNOWLEDGE

Students who have passed the module should be able to

- Describe one or more advanced programmes for numerical calculations of complex and/or big amounts of data
- Explain the theory behind the programmes

#### SKILLS

- Apply one of the programmes for numerical calculation of a selected process in the laboratory or at pilot scale
- Evaluate the results of simulations and find and correct any wrong input data
- Write a project report following the standards of the field of study, include relevant original scientific literature, use the correct terminology and communicate the research-based foundation, problem and results of the project in writing, graphically and orally in a coherent way
- Assess and select relevant original scientific literature and current scientific methods, models and other tools used in the project and assess the problem of the project and results in relevant scientific contexts and social conditions

#### COMPETENCES

- Present the setup of the model, the calculations and estimations of the results and to propose further work based on the results of calculation
- Handle the planning, implementation and management of complex and unpredictable research and/or developmental tasks and take professional responsibility for implementing academic assignments and interdisciplinary collaborations
- Take responsibility for own professional development and specialization

#### TYPE OF INSTRUCTION

Project work

#### EXTENT AND EXPECTED WORKLOAD

450 hours

## EXAM

### EXAMS

Name of exam	Process Modelling
Type of exam	Oral exam based on a project
ECTS	15
Assessment	7-point grading scale
Type of grading	External examination
Criteria of assessment	As stated in the Joint Programme Regulations

## FACTS ABOUT THE MODULE

Danish title	Procesmodellering
Module code	K-KT-K2-15
Module type	Project
Duration	1 semester
Semester	Spring
ECTS	15
Language of instruction	English
Empty-place Scheme	Yes
Location of the lecture	Campus Esbjerg
Responsible for the module	<a href="#">Rudi Pankratz Nielsen</a>
Time allocation for external examiners	B

## ORGANISATION

Study Board	Study Board of Biotechnology, Chemistry and Environmental Engineering
Department	Department of Chemistry and Bioscience
Faculty	Faculty of Engineering and Science

# PROCESS SIMULATION AND INSTRUMENTATION

2018/2019

## CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

### LEARNING OBJECTIVES

#### KNOWLEDGE

Students who have passed the module should be able to

- Account for the principles of process simulation
- Explain process optimization using process simulation
- Account for computational aspects of phase equilibria
- Account for instrumentation and PFD & PID's
- Describe commercial process simulators

#### SKILLS

- Illustrate an actual process in a PFD
- Convert a PFD into a working process simulation
- Perform both steady-state and dynamic simulations

#### COMPETENCES

- Investigate a given case using simulation tools
- Select an appropriate thermodynamic model for a given case

### TYPE OF INSTRUCTION

Lectures, practical exercises, group and individual instructions

### EXTENT AND EXPECTED WORKLOAD

150 hours

## EXAM

### EXAMS

Name of exam	Process Simulation and Instrumentation
Type of exam	Written or oral exam
ECTS	5
Assessment	Passed/Not Passed
Type of grading	Internal examination
Criteria of assessment	As stated in the Joint Programme Regulations

## FACTS ABOUT THE MODULE

Danish title	Processsimulering og instrumentering
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## Master of Science (MSc) in Engineering (Chemical Engineering)

Module code	K-KT-K2-8
Module type	Course
Duration	1 semester
Semester	Spring
ECTS	5
Language of instruction	English
Empty-place Scheme	Yes
Location of the lecture	Campus Esbjerg
Responsible for the module	<a href="#">Rudi Pankratz Nielsen</a>

### ORGANISATION

Study Board	Study Board of Biotechnology, Chemistry and Environmental Engineering
Department	Department of Chemistry and Bioscience
Faculty	Faculty of Engineering and Science

# WATER TREATMENT

2018/2019

## CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

### LEARNING OBJECTIVES

#### KNOWLEDGE

Students who have passed the module should be able to

- Describe different water bodies in the society and its surroundings and their interaction with atmosphere
- Describe natural and antropogenic pollutants, their origin and some ways to eliminate them
- Explain which chemical compounds are normally present in groundwater, surface water, sea water, brine and at which levels based on original water and weathering processes
- Describe a normal Danish drinking water treatment system and a Danish waste water treatment system

#### SKILLS

- Select a methodology from an array of advanced oxidative and reductive processes that separately or in common can solve a given recalcitrant water pollution problem
- Select unit operations and purification methods for produced water and other industrial water types

#### COMPETENCES

- Use proper terminology in oral, written and graphical communication and documentation within water treatment technology

#### TYPE OF INSTRUCTION

Lectures supplemented with project work, workshops, presentation seminars, laboratory tests and cases

#### EXTENT AND EXPECTED WORKLOAD

150 hours

## EXAM

### EXAMS

Name of exam	Water Treatment
Type of exam	Oral exam
ECTS	5
Assessment	7-point grading scale
Type of grading	Internal examination
Criteria of assessment	As stated in the Joint Programme Regulations

## FACTS ABOUT THE MODULE

Danish title	Teknisk vandbehandling
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## Master of Science (MSc) in Engineering (Chemical Engineering)

Module code	K-KT-K2-9
Module type	Course
Duration	1 semester
Semester	Spring
ECTS	5
Language of instruction	English
Empty-place Scheme	Yes
Location of the lecture	Campus Esbjerg
Responsible for the module	<a href="#">Jens Muff</a>

### ORGANISATION

Study Board	Study Board of Biotechnology, Chemistry and Environmental Engineering
Department	Department of Chemistry and Bioscience
Faculty	Faculty of Engineering and Science



# POLYMERS AND PROPERTIES OF POLYMERS

2018/2019

## CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

### LEARNING OBJECTIVES

#### KNOWLEDGE

Students who have passed the module should be able to

- Explain polymerisation processes
- Describe the influence of segments in polymers on the properties
- Account for viscosity and solubility parameters for polymers
- Account for degradation of polymers
- Account for permeability and migration in polymers
- Describe additives and their influence on the properties
- Describe a polymer system

#### SKILLS

- Analyze and describe analytical methods to receive the knowledge about the polymer system and of the properties for the system
- Describe the properties of a polymer system

#### COMPETENCES

- Apply proper terminology in oral, written and graphical communication and documentation within polymers and properties of polymer systems

#### TYPE OF INSTRUCTION

Lectures and theoretical exercises

#### EXTENT AND EXPECTED WORKLOAD

150 hours

## EXAM

### EXAMS

Name of exam	Polymers and Properties of Polymers
Type of exam	Written or oral exam
ECTS	5
Assessment	7-point grading scale
Type of grading	Internal examination
Criteria of assessment	As stated in the Joint Programme Regulations

## FACTS ABOUT THE MODULE

Danish title	Polymerer og polymeres egenskaber
Module code	K-KT-K2-10
Module type	Course
Duration	1 semester
Semester	Spring
ECTS	5
Language of instruction	English
Empty-place Scheme	Yes
Location of the lecture	Campus Esbjerg
Responsible for the module	<a href="#">Jesper de Claville Christiansen</a>

## ORGANISATION

Study Board	Study Board of Biotechnology, Chemistry and Environmental Engineering
Department	Department of Chemistry and Bioscience
Faculty	Faculty of Engineering and Science

# SPECIALISATION IN CHEMICAL ENGINEERING

2018/2019

## CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

### LEARNING OBJECTIVES

#### KNOWLEDGE

Students who have passed the module should be able to

- Account for at least one of the following areas
  - Bio energy
  - Ceramics and photocatalysis
  - Chemicals in oil and gas industry
  - Environmental technology
  - Fossil fuels and enhanced oil recovery
  - Fungal Technology
  - Natural products
  - Polymer technology
  - Spectroscopy and data analysis

#### SKILLS

- Demonstrate skills in at least one of the following areas:
  - Execution of laboratory experiments
  - Application of physico-chemical models to chemical engineering products
  - Processes or process units, application of process simulators to chemical engineering related processes (e.g. separation, kinetics)
- Analysis of experimental data
- Write a project report following the standards of the field of study, include relevant original scientific literature, use the correct terminology and communicate the research-based foundation, problem and results of the project in writing, graphically and orally in a coherent way
- Assess and select relevant original scientific literature and current scientific methods, models and other tools used in the project and assess the problem of the project and results in relevant scientific contexts and social conditions

#### COMPETENCES

- Identify key aspects of the problem/process under investigation
- Select and combine experimental and theoretical methods, as appropriate, in order to solve complex problems in chemical engineering
- Critical review of the methods used and the results obtained on the project work
- Handle the planning, implementation and management of complex and unpredictable research and/or developmental tasks and take professional responsibility for implementing academic assignments and interdisciplinary collaborations
- Take responsibility for own professional development and specialization

#### TYPE OF INSTRUCTION

- Project work

#### EXTENT AND EXPECTED WORKLOAD

900 hours

## EXAM

### EXAMS

Name of exam	Specialisation in Chemical Engineering
Type of exam	Oral exam based on a project
ECTS	30
Assessment	7-point grading scale
Type of grading	External examination
Criteria of assessment	As stated in the Joint Programme Regulations

## FACTS ABOUT THE MODULE

Danish title	Specialisering i kemiteknologi
Module code	K-KT-K3-19
Module type	Project
Duration	1 semester
Semester	Autumn
ECTS	30
Language of instruction	English
Empty-place Scheme	Yes
Location of the lecture	Campus Esbjerg
Responsible for the module	<a href="#">Jens Muff</a>
Time allocation for external examiners	B

## ORGANISATION

Study Board	Study Board of Biotechnology, Chemistry and Environmental Engineering
Department	Department of Chemistry and Bioscience
Faculty	Faculty of Engineering and Science

# PROJECT WORK IN AN EXTERNAL ORGANISATION

2018/2019

## CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

### LEARNING OBJECTIVES

#### KNOWLEDGE

Students who have passed the module should be able to

- Explain the scientific basis of the work carried out by the external organisation

#### SKILLS

- Master the scientific methods and general skills related to the project work in the external organisation
- Write a report following the standards of the field of study, use the correct terminology and document extensive use of relevant and original scientific literature, communicate and discuss the project's foundation, problem and results in writing, graphically and verbally in a coherent way
- Critically assess and select relevant original scientific literature and current scientific methods, models and other tools used in the project and assess and discuss the problem of the project and results in relevant scientific contexts and social conditions
- Evaluate the potential of the project for further development, assessing and incorporating relevant economic, ethical, environmental and other socially relevant factors

#### COMPETENCES

- Participate in development, innovation and research and use scientific methods to solve complex tasks
- Take professional responsibility to implement independent assignments and interdisciplinary collaborations
- Independently take responsibility for own professional development and specialization

#### TYPE OF INSTRUCTION

- Project work, supervised by an external supervisor in collaboration with an internal supervisor at Aalborg University
- Project work in an external organisation must be in areas of relevance to the competence profile of the program

#### EXTENT AND EXPECTED WORKLOAD

900 hours

## EXAM

### EXAMS

Name of exam	Project Work in an External Organisation
Type of exam	Oral exam based on a project
ECTS	30
Assessment	Passed/Not Passed
Type of grading	Internal examination
Criteria of assessment	As stated in the Joint Programme Regulations

## FACTS ABOUT THE MODULE

Danish title	Projektarbejde i en ekstern organisation
Module code	K-KT-K3-20
Module type	Project
Duration	1 semester
Semester	Autumn
ECTS	30
Language of instruction	English
Empty-place Scheme	Yes
Location of the lecture	Campus Esbjerg
Responsible for the module	<a href="#">Erik Gydesen Søgaard</a>

## ORGANISATION

Study Board	Study Board of Biotechnology, Chemistry and Environmental Engineering
Department	Department of Chemistry and Bioscience
Faculty	Faculty of Engineering and Science

# MASTER'S THESIS IN CHEMICAL ENGINEERING

2018/2019

## CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

### LEARNING OBJECTIVES

#### KNOWLEDGE

Students who have passed the module should be able to

- Explain the scientific basis and scientific issues in chemical engineering
- Explain the highest international research within the thesis subject area

#### SKILLS

- Master the scientific methods and general skills related to the thesis subject area
- Write a project report following the standards of the field of study, use the correct terminology and document extensive use of relevant and original scientific literature, and communicate and discuss the project's research-based foundation, problem and results in writing, graphically and verbally in a coherent way
- Critically assess and select relevant original scientific literature and current scientific methods, models and other tools used in the project and assess and discuss the problem of the project and results in relevant scientific contexts and social conditions
- Evaluate the potential of the project for further development, assessing and incorporating relevant economic, ethical, environmental and other socially relevant factors

#### COMPETENCES

- Participate in and independently implement technological and scientific development and research, develop and implement experimental work and solve complex tasks using scientific methods
- Handle the planning, implementation and management of complex and unpredictable research and/or developmental tasks and take professional responsibility to implement independent academic assignments and interdisciplinary collaborations
- Independently take responsibility for own professional development and specialization

#### TYPE OF INSTRUCTION

- Project work
- A long Master's thesis of more than 30 ECTS must include work of experimental nature to an extent that corresponds to the ECTS load of the thesis

#### EXTENT AND EXPECTED WORKLOAD

900 hours

### EXAM

#### EXAMS

Name of exam	Master's Thesis in Chemical Engineering
Type of exam	Oral exam based on a project
ECTS	30
Assessment	7-point grading scale

Type of grading	External examination
Criteria of assessment	As stated in the Joint Programme Regulations

## FACTS ABOUT THE MODULE

Danish title	Kandidatspeciale i kemiteknik
Module code	K-KT-K4-20
Module type	Project
Duration	1 semester
Semester	Spring
ECTS	30
Language of instruction	English
Location of the lecture	Campus Esbjerg
Responsible for the module	<a href="#">Jens Muff</a>
Time allocation for external examiners	D

## ORGANISATION

Study Board	Study Board of Biotechnology, Chemistry and Environmental Engineering
Department	Department of Chemistry and Bioscience
Faculty	Faculty of Engineering and Science



# MASTER'S THESIS IN CHEMICAL ENGINEERING

2018/2019

## CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

### LEARNING OBJECTIVES

#### KNOWLEDGE

Students who have passed the module should be able to

- Explain the scientific basis and scientific issues in chemical engineering
- Explain the highest international research within the thesis subject area

#### SKILLS

- Master the scientific methods and general skills related to the thesis subject area
- Write a project report following the standards of the field of study, use the correct terminology and document extensive use of relevant and original scientific literature, communicate and discuss the project's research-based foundation, problem and results in writing, graphically and verbally in a coherent way
- Critically assess and select relevant original scientific literature and current scientific methods, models and other tools used in the project, assess and discuss the problem of the project and results in relevant scientific contexts and social conditions
- Evaluate the potential of the project for further development, assessing and incorporating relevant economic, ethical, environmental and other socially relevant factors

#### COMPETENCES

- Participate in and independently implement technological and scientific development and research, develop and implement experimental work and solve complex tasks using scientific methods
- Handle the planning, implementation and management of complex and unpredictable research and/or developmental tasks and take professional responsibility to implement independent academic assignments and interdisciplinary collaborations
- Independently take responsibility for own professional development and specialization

#### TYPE OF INSTRUCTION

- Project work
- A long Master's thesis of more than 30 ECTS must include work of experimental nature to an extent that corresponds to the ECTS load of the thesis

#### EXTENT AND EXPECTED WORKLOAD

1800 hours

### EXAM

#### EXAMS

Name of exam	Master's Thesis in Chemical Engineering
Type of exam	Master's thesis/final project
ECTS	60
Assessment	7-point grading scale

Type of grading	External examination
Criteria of assessment	As stated in the Joint Programme Regulations

## FACTS ABOUT THE MODULE

Danish title	Kandidatspeciale i kemiteknik
Module code	K-KT-K3-24
Module type	Project
Duration	2 semesters
Semester	Autumn
ECTS	60
Language of instruction	English
Location of the lecture	Campus Esbjerg
Responsible for the module	<a href="#">Jens Muff</a>
Time allocation for external examiners	D

## ORGANISATION

Study Board	Study Board of Biotechnology, Chemistry and Environmental Engineering
Department	Department of Chemistry and Bioscience
Faculty	Faculty of Engineering and Science