AALBORG UNIVERSITET

BACHELOR OF ENGINEERING IN CHEMICAL ENGINEERING AND BIOTECHNOLOGY, 2018 (ESBJERG)

BACHELOR OF ENGINEERING
ESBJERG

MODULES INCLUDED IN THE CURRICULUM

TABLE OF CONTENTS

CHEMICAL AND BIO INDUSTRIAL PRODUCTS II

2018/2019

PREREQUISITE/RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

The module adds to the knowledge obtained in Chemical and Bio Industrial Products I

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

LEARNING OBJECTIVES

KNOWLEDGE

Students who have passed the module should be able to

- Define and understand the concepts, methods, theories and models used in the project

SKILLS

- Work safely in the laboratory, evaluate and use appropriate protectives, use relevant sources of information, handle chemicals and other materials safely, dispose of waste according to regulations and develop workplace instructions
- Communicate the problem and results in writing, graphically and orally in a coherent way

COMPETENCES

- Handle planning and implementation of a project
- Identify and develop own potentials for further education in the field of study

TYPE OF INSTRUCTION

- Project work

EXTENT AND EXPECTED WORKLOAD

300 hours

EXAM

EXAMS

Name of exam	Chemical and Bio Industrial Products II
Type of exam	Oral exam based on a project
ECTS	10
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	Kemiske og bioindustrielle produkter II
Module code	K-KT-B1-11
Module type	Project
Duration	1 semester
Semester	Autumn
ECTS	10
Language of instruction	Danish and English
Empty-place Scheme	Yes
Location of the lecture	Campus Esbjerg
Responsible for the module	Jens Muff

ORGANISATION

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

CHEMICAL AND BIO INDUSTRIAL PRODUCTS I

2018/2019

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

LEARNING OBJECTIVES

KNOWLEDGE

Students who have passed the module should be able to

- Explain fundamental aspects of chemical engineering and biotechnology

SKILLS

- Communicate the problem and results of the project in writing and orally
- Prepare a hypothesis that identifies a problem and forms the basis for further work within the project's area of expertise

TYPE OF INSTRUCTION

- Project work

EXTENT AND EXPECTED WORKLOAD

150 hours

EXAM

EXAMS

Name of exam	Chemical and Bio Industrial Products I
Type of exam	Oral exam based on a project
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	Kemiske og bioindustrielle produkter I
Module code	K-KT-B1-12
Module type	Project
Duration	1 semester
Semester	Autumn
ECTS	5
Language of instruction	Danish and English

Empty-place Scheme	Yes
Location of the lecture	Campus Esbjerg
Responsible for the module	Jens Muff

ORGANISATION

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

PROBLEM-BASED LEARNING IN SCIENCE, TECHNOLOGY AND SOCIETY

2018/2019

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

LEARNING OBJECTIVES

KNOWLEDGE

- Be able to explain fundamental teaching theories
- Be able to explain techniques to plan and manage project work
- Be able to explain different approaches to problem based learning (PBL), including the Aalborg Model based on problems related to society and/or humanistic coherence
- Be able to explain different approaches to analysis and judgement of problems and solutions related to engineering, natural and medical science, seen in a scientific, ethic and social perspective
- Be able to describe specific methods within the subject area to perform such an analysis and assessment

SKILLS

- Be able to plan and manage a problem-based project work
- Be able to analyse the study group's organisation and cooperation of the project work with regard to identification of the strong and weak sides and on this basis come up with solutions of how to improve teamwork in future groups
- Be able to reflect on the reasons for a group conflict, if any, and come up with possible solutions
- Be able to analyse and evaluate own study and learning effort to identify strong and weak sides, and from this consider the further course of study and study effort
- Be able to reflect on the applied methods in a scientific perspective
- Be able to point out relevant focus, concepts and methods to find and develop solutions considering the social and humanistic coherence in which the solution should be incorporated

COMPETENCES

- Be able to enter in a team-based project work
- Be able to document and present the project work
- Be able to reflect and develop own learning
- Be able to enter in and optimize collaborative learning processes
- Be able to reflect on the professional work in relation to the surrounding society

TYPE OF INSTRUCTION

The course is a mix of lectures, seminars, workshops, group sessions and self-study.

EXTENT AND EXPECTED WORKLOAD

Since it is a 5 ECTS course, the work load is expected to be 150 hours for the student.

EXAM

EXAMS

Name of exam	Problem-based Learning in Science, Technology and Society
Type of exam	Written exam The assessment is based on a written exercise handed in individually.

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	Problembaseret læring i videnskab, teknologi og samfund
Module code	N-EN-B1-5
Module type	Course
Duration	1 semester
Semester	Autumn
ECTS	5
Language of instruction	Danish and English
Empty-place Scheme	Yes
Location of the lecture	Campus Aalborg, Campus Esbjerg, Campus Copenhagen
Responsible for the module	Annette Grunwald, Søren Rosenlund Frimodt-Møller

ORGANISATION

Study Board	Study Board of Energy
Department	Department of Energy Technology
Faculty	Faculty of Engineering and Science

CALCULUS

2018/2019

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

LEARNING OBJECTIVES

KNOWLEDGE

- Have knowledge about definitions, results and techniques within the theory of differentiation and integration of functions of two or more variables
- Have knowledge about the trigonometric functions and their inverse functions
- Have knowledge of the description of simple surfaces in orthogonal, polar and cylindrical coordinates
- Have knowledge about complex numbers, including computation rules and their representations
- Have knowledge about factorisation of polynomials over the complex numbers
- Have knowledge about the complex exponential function, its characteristics and its connection with trigonometric functions
- Have knowledge about curves in the plane (in both rectangular and polar coordinates) and space, and parameterisations, tangent vectors and curvatures of such curves
- Have knowledge about the theory of second order linear differential equations with constant coefficients

SKILLS

- Be able to visualize functions of two and three variables using graphs, level curves and level surfaces
- Be able to determine local and global extrema for functions of two and three variables
- Be able to determine surface area, volume, moment of inertia, etc. using integration theory
- Be able to approximate functions of one variable using Taylor's formula, and to use linear approximations for functions of two or more variables
- Be able to perform arithmetic computations with complex numbers
- Be able to find the roots in the complex quadratic equation and perform factorisation of polynomials in simple cases
- Be able to solve linear second order differential equations with constant coefficients, in general, and with initial conditions
- Be able to reason through the use the concepts, results and theories in simple concrete and abstract problems

COMPETENCES

- Be able to develop and strengthen knowledge, comprehension and application of mathematical theories and methods in other subject areas
- Be able to reason and argue on the basis of the given conditions using mathematical consepts fra calculus

TYPE OF INSTRUCTION

Lectures with exercises.

EXTENT AND EXPECTED WORKLOAD

Since it is a 5 ECTS course, the work load is expected to be 150 hours for the student.

EXAM

EXAMS

Name of exam	Calculus
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. http://www.engineering.aau.dk/uddannelse/Studieadministration/

FACTS ABOUT THE MODULE

Danish title	Calculus
Module code	F-MAT-B1-3
Module type	Course
Duration	1 semester
Semester	Autumn
ECTS	5
Language of instruction	Danish and English
Empty-place Scheme	Yes
Location of the lecture	Campus Aalborg, Campus Esbjerg
Responsible for the module	Morten Grud Rasmussen

ORGANISATION

Study Board	Study Board of Mathematics, Physics and Nanotechnology
Department	Department of Mathematical Sciences
Faculty	Faculty of Engineering and Science

GENERAL CHEMISTRY

2018/2019

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

LEARNING OBJECTIVES

KNOWLEDGE

Students who have passed the module should be able to

- Explain fundamental chemical and physico-chemical principles for reactions and equilibria
- Explain the structure of the atom, chemical bonding and intermolecular forces
- Account for atomic orbitals, the electron configuration of the elements and the physical description of the atom that form the basis of the periodic table
- Describe different models for development of molecular orbitals that describe the molecular covalent bond and geometry of molecules
- Explain fundamental differences on redox reactions, acid-base reactions, solubility reactions and chemical complexation
- Account for fundamental thermodynamics
- Account for fundamental electrochemistry, including galvanic elements and electrolysis
- Explain fundamental reaction kinetics and be able to explain reaction rates and reaction orders for selected reactions

SKILLS

- Balance chemical reactions and perform appropriate stoichiometric calculations and mass balances
- Explain the electron configurations of atoms, ions and molecules and their influence on the geometric size of the particle based on orbital and VSEPR theory
- Calculate pH and redox-potentials for relevant equilibria
- Calculate enthalpy, entropy, and Gibbs free energy for chemical reactions
- Develop a Nernst equation for calculation of the electromotive force of a redox reaction
- Calculate yields of electrolytic reactions
- Develop rate equations describing chemical reaction kinetics, explain the order of the constituent components and the overall reaction and explain the parameters of the rate constant
- Model the kinetics of simple reaction mechanisms for simulation and illustration of the time course of chemical reactions

COMPETENCES

- Plan and dimension simple chemical laboratory experiments based on knowledge of the chemical and physical conditions where these reactions happen

TYPE OF INSTRUCTION

- Lectures, exercises, laboratory work, writing of laboratory journals

EXTENT AND EXPECTED WORKLOAD

150 hours

EXAM

PREREQUISITE FOR ENROLLMENT FOR THE EXAM

- Approved active participation in the teaching is a prerequisite for participation in the regular exam

EXAMS

Name of exam	General Chemistry
Type of exam	Written or oral exam
ECTS	5
Assessment	7-point grading scale
Type of grading	Internal examination
Criteria of assessment	Er angivet i fællesbestemmelserne

FACTS ABOUT THE MODULE

Danish title	Almen kemi
Module code	K-KT-B1-1
Module type	Course
Duration	1 semester
Semester	Autumn
ECTS	5
Language of instruction	Danish and English
Empty-place Scheme	Yes
Location of the lecture	Campus Esbjerg
Responsible for the module	Jens Muff

ORGANISATION

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

CHEMICAL REACTIONS IN NATURAL AND TECHNICAL SYSTEMS

2018/2019

PREREQUISITE/RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

The module adds to the knowledge obtained in Chemical and Bio Industrial Products II

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

LEARNING OBJECTIVES

KNOWLEDGE

Students who have passsed the module should be able to

- Explain concepts, models, theories and methods of professional relevance to the project
- Account for practical laboratory work including risk safety procedures and waste management

SKILLS

- Plan and carry out chemical experiments in the laboratory in a safe manner, keep records of the conducted experiments and draw relevant conclusions from the results obtained
- Write a project report following the standards of the field of study and communicate the problem and results in writing, graphically and orally in a coherent way, including the relationship between problem formulation, project export and main conclusions
- Asses the problem of the project and results in relevant professional and social contexts and identify relevant stakeholders

COMPETENCES

- Organize group work and cooperation with supervisors and undertake planning, implementation and management of a project, taking into account past experiences
- Identify and develop own potentials for further education in the field of study

TYPE OF INSTRUCTION

- Project work

EXTENT AND EXPECTED WORKLOAD

450 hours

EXAM

EXAMS

Name of exam	Chemical Reactions in Natural and Technical Systems
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	Kemiske reaktioner i naturlige og tekniske systemer
Module code	K-KT-D2-4
Module type	Project
Duration	1 semester
Semester	Spring
ECTS	15
Language of instruction	Danish and English
Empty-place Scheme	Yes
Location of the lecture	Campus Esbjerg
Responsible for the module	Jens Muff
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

BIOLOGISK AKTIVE MOLEKYLER – INTRODUKTION TIL CELLEBIOLOGI OG BIOLOGISK KEMI

2018/2019

FORUDSÆTNINGER/ANBEFALEDE FORUDSÆTNINGER FOR AT DELTAGE I MODULET

Modulet bygger videre på viden opnået i Almen kemi

MODULETS INDHOLD, FORLØB OG PÆDAGOGIK

LÆRINGSMÅL

VIDEN

- Redegøre for cellers opbygning
- Redegøre for biologisk aktive molekylers strukturer, egenskaber og funktion
- Forklare den cellulære energiomsætning
- Redegøre for DNA opbygning og replikation
- Redegøre for bioteknologiske teknologier
- Redegøre for proteins opbygning og funktion
- Redegøre for lipider og membraners opbygning og funktion
- Beskrive cellen, dens organeller og indholdsstoffer
- Redegøre for metabolisme
- Redegøre for energiomsætningen i celler
- Redegøre for enzymers virkemåde og regulering
- Redegøre for hvordan DNA kan bruges i moderne rekombinante teknologier
- Redegøre for samspillet mellem kemi og biologi på celleniveau

FÆRDIGHEDER

- Anvende faglitteratur om cellebiologiske emner

UNDERVISNINGSFORM

Forelæsninger samt teoretiske og praktiske øvelser

OMFANG OG FORVENTET ARBEJDSINDSATS

150 timer

EKSAMEN

PRØVER

Prøvens navn	Biologisk aktive molekyler – introduktion til cellebiologi og biologisk kemi
Prøveform	Skriftlig eller mundtlig Godkendt aktiv deltagelse i undervisningen er forudsætning for deltagelse i den ordinære prøve
ECTS	5
Bedømmelsesform	Bestået/ikke bestået
Censur	Intern prøve

Vurderingskriterier	Er angivet i fællesbestemmelserne

FAKTA OM MODULET

Engelsk titel	Biological Active Molecules – Introduction to Cell Biology and Biological Chemistry
Modulkode	K-KT-D2-1
Modultype	Kursus
Varighed	1 semester
Semester	Forår
ECTS	5
Undervisningssprog	Dansk
Tomplads	Ja
Undervisningssted	Campus Esbjerg
Modulansvarlig	Jens Laurids Sørensen

ORGANISATION

Studienævn	Studienævnet for Kemi, Miljø og Bioteknologi
Institut	Institut for Kemi og Biovidenskab
Fakultet	Det Ingeniør- og Naturvidenskabelige Fakultet

GRUNDLÆGGENDE KEMISK PROCESTEKNIK OG TERMODYNAMIK

2018/2019

MODULETS INDHOLD, FORLØB OG PÆDAGOGIK

LÆRINGSMÅL

VIDEN

- Redegøre for grundlæggende procestekniske begreber, herunder systemer, systemgrænser, procestyper, procesenheder og procesvariable
- Redegøre for begreberne energi, energioverførsel og effekt
- Redegøre for systematikken for opstilling og beregning af balanceligninger
- Forklare termodynamikkens hovedsætninger
- Redegøre for ideale gasser
- Redegøre for varme, arbejde og indre energi
- Redegøre for termodynamiske materialeegenskaber
- Redegøre for Boltzmann-fordelingen
- Forklare entropi
- Forklare enthalpi og kunne definere standard enthalpiændringer ved fysiske processer og kemiske reaktioner
- Redegøre for Gibbs fri energi, faseligevægte for rene stoffer samt fasediagrammer
- Redegøre for kemisk potentiale og termodynamisk ligevægt for kemiske reaktioner

FÆRDIGHEDER

- Læse procesdiagrammer
- Foretage en relevant afgrænsning og/eller opdeling af en given teknisk, kemisk eller biologisk proces og udfærdige et blok- eller procesdiagram herfor
- Omregne mellem enheder
- Opstille og løse massebalancer for stationære ikke-reaktive systemer og reaktive systemer
- Regne på ideale gasser og ideale gasblandinger
- Estimere kompressibilitetsfaktoren for en real gas ved givne procesbetingelser
- Anvende fasediagrammer og damptabeller
- Foretage termokemiske beregninger
- Beregne ligevægtsforhold på baggrund af termodynamiske data
- Opstille og løse energibalancer for stationære systemer
- Anvende metoder og teorier inden for kemisk procesteknik og termodynamik på simple modelsystemer

KOMPETENCER

- Anvende den termodynamiske teori og de procestekniske metoder til at forstå, beskrive og løse problematikker inden for fagområder som analytisk kemi, materialelære, separationsteknik, kemisk reaktionsteknik og procesdesign

UNDERVISNINGSFORM

Forelæsninger og teoretiske øvelser

OMFANG OG FORVENTET ARBEJDSINDSATS

150 timer

EKSAMEN

PRØVER

Prøvens navn	Grundlæggende kemisk procesteknik og termodynamik
Prøveform	Skriftlig eller mundtlig
ECTS	5
Bedømmelsesform	7-trins-skala
Censur	Intern prøve
Vurderingskriterier	Er angivet i fællesbestemmelserne

FAKTA OM MODULET

Engelsk titel	Fundamental Chemical Engineering and Thermodynamics
Modulkode	K-KT-D2-2
Modultype	Kursus
Varighed	1 semester
Semester	Forår
ECTS	5
Undervisningssprog	Dansk
Tomplads	Ja
Undervisningssted	Campus Esbjerg
Modulansvarlig	Inge-Lise Hansen

ORGANISATION

Studienævn	Studienævnet for Kemi, Miljø og Bioteknologi
Institut	Institut for Kemi og Biovidenskab
Fakultet	Det Ingeniør- og Naturvidenskabelige Fakultet

LINEAR ALGEBRA

2018/2019

PREREQUISITE/RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

The module builds on knowledged from the module Calculus.

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

LEARNING OBJECTIVES

KNOWLEDGE

- Have knowledge about definitions, results and techniques in the theory of systems of linear equations
- Be able to demonstrate insight into linear transformations and their connection to matrices
- Have obtained knowledge about the computer program MATLAB, and its application related to linear algebra
- Have acquired knowledge about simple matrix operations
- Have knowledge about invertible matrices and invertible linear transformation
- Have knowledge about the vector space R^n and its subspaces
- Have knowledge about linearly dependent vectors and linearly independent vectors, and the dimension and basis of subspaces
- Have knowledge about the determinant of a matrix
- Have knowledge about eigenvalues and eigenvectors of matrices and their application
- Have knowledge about projections and orthonormal bases
- Have knowledge about first-order differential equations, and systems of linear differential equations

SKILLS

- Be able to apply theory and calculation techniques for systems of linear equations to determine solvability and determine complete solutions and their structure
- Be able to represent systems of linear equations by means of matrix equations, and vice versa
- Be able to determine and apply the reduced echelon form of a matrix
- Be able to use elementary matrices in connection with Gauss elimination and inversion of matrices
- Be able to determine linear dependence or linear independence of sets of few vectors
- Be able to determine dimension of and basis of subspaces
- Be able to determine the matrix for a given linear transformation, and vice versa
- Be able to solve simple matrix equations
- Be able to calculate the inverse of small matrices
- Be able to determine the dimension of and basis for kernel and column spaces
- Be able to calculate determinants and apply the result of this calculation
- Be able to calculate eigenvalues and eigenvectors for simple matrices
- Be able to determine whether a matrix is diagonalizable, and if so, be able to diagonalize a simple matrix
- Be able to calculate the orthogonal projection onto a subspace of R^n
- Be able to solve separable and linear first order differential equations, in general, and with initial conditions

COMPETENCES

- Be able to develop and strengthen knowledge, comprehension and application of mathematical theories and methods in other subject areas
- Given certain pre-conditions, be able to make mathematical deductions and arguments based on concepts from linear algebra

TYPE OF INSTRUCTION

Lectures with exercises.

EXTENT AND EXPECTED WORKLOAD

Since it is a 5 ECTS course, the work load is expected to be 150 hours for the student.

EXAM

EXAMS

Name of exam	Linear Algebra
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. http://www.engineering.aau.dk/uddannelse/Studieadministration/

FACTS ABOUT THE MODULE

Danish title	Lineær algebra
Module code	F-MAT-B2-2
Module type	Course
Duration	1 semester
Semester	Spring
ECTS	5
Language of instruction	Danish and English
Empty-place Scheme	Yes
Location of the lecture	Campus Aalborg, Campus Esbjerg
Responsible for the module	Morten Grud Rasmussen

ORGANISATION

Study Board	Study Board of Mathematics, Physics and Nanotechnology
Department	Department of Mathematical Sciences
Faculty	Faculty of Engineering and Science

ANALYSIS OF CHEMICAL SYSTEMS

2018/2019

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

LEARNING OBJECTIVES

KNOWLEDGE

Students who have passed the module should be able to

- Explain the fundamental physical principles that underlie the chemical analysis apparatus used in the project
- Explain the fundamental physical principles underlying alternatives to the selected instrumental chemical analysis techniques
- Explain the chemistry that underlies sample preparation to the instrumental chemical analysis techniques that are selected above
- Describe standard statistical methods used in analytical chemistry

SKILLS

- Perform relevant stoichiometric calculations and use ordinary glassware in the laboratory
- Perform analytical chemical experiments in accordance with the regulatory and achieve a reproducible result
- Write down and reconcile all chemical reaction schemes that underlie the analysis regulatory
- Calculate the thermodynamic affinity for the reactions used in the basis of the analysis
- Perform the relevant statistical calculations on the results and select one of the analytical methods for validation
- Perform general uncertainty calculations on the results obtained
- Explain safety rules and phrases for the analysis and the chemicals used
- Write a project report following the standards of the field of study, include relevant literature, use the correct terminology and communicate the problem and results in writing, graphically and orally in a coherent way
- Justify the choice of methods, models and other tools used in the project and asses the problem of the project and results in relevant professional contexts

COMPETENCES

- Select the best possible analytical equipment in the laboratory for a chemical analysis of a given product or a process, taking economic and temporal factors into account
- Handle the planning, implementation and management of a project and handle complex and development-oriented tasks during the project work and contribute to the project group's work and results
- Identify own learning needs for continued development and education in the field of study

TYPE OF INSTRUCTION

- Project work

EXTENT AND EXPECTED WORKLOAD

450 hours

EXAM

EXAMS

Name of exam	Analysis of Chemical Systems
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	Analyse af kemiske systemer
Module code	K-KT-B3-13
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	Morten Enggrob Simonsen
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

METHODS IN QUANTITATIVE CHEMICAL ANALYSIS

2018/2019

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

LEARNING OBJECTIVES

KNOWLEDGE

Students who have passed the module should be able to

- Explain the fundamental physical principles governing selected apparatus for instrumental chemical analysis, including chromatographic and spectroscopic techniques
- Explain the fundamental physical principles forming the basis for alternatives to the selected instrumental chemical analysis methods
- Account for the chemistry that forms the basis of sample preparation for the above selected instrumental chemical analysis techniques
- Account for spectroscopic methods that may be utilized for qualitative analysis of various organic, inorganic or organometallic substances

SKILLS

- Perform relevant stoichiometric calculations and use common glassware in the laboratory
- Perform analytical chemical experiments based on written instructions and achieve a reproducible result
- Write and balance any and all chemical reaction schemes forming the foundation of the instructions for the analysis
- Calculate the thermodynamic affinity for the applied reactions from the point of reference
- Perform relevant statistical calculations on the results of a series of analysis on selected instruments
- Perform general calculations of the uncertainty in the measurements based on the obtained results
- Identify appropriate experimental methods for qualitative determination of substance properties

COMPETENCES

- Select and evalaute imaginable analysis equipment in the laboratory for a chemical analysis of a product or a given process under consideration of time and economical aspects

TYPE OF INSTRUCTION

- Lectures, laboratory exercises and theoretical exercises

EXTENT AND EXPECTED WORKLOAD

150 hours

EXAM

EXAMS

Name of exam	Methods in Quantitative Chemical Analysis
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	Metoder til kvantitativ kemisk analyse
Module code	K-KT-B3-2
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	Morten Enggrob Simonsen

ORGANISATION

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

INORGANIC AND ORGANIC CHEMISTRY

2018/2019

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

LEARNING OBJECTIVES

KNOWLEDGE

Students who have passed the module should be able to

- Explain the concept of activity and activity coefficients of ions in solution
- Explain the fundamental thermodynamics underlying the calculation of equilibrium constants of coupled equilibria systems
- Describe properties of solids that rely on the atomic structure of metals and ionic compounds
- Describe stereochemistry and coordination chemistry of chemical complexation
- Explain bonding of organic carbon-based compounds and stereochemistry
- Account for functional groups, nomenclature, common trivial names and physical properties
- Account for reactive intermediates (radicals, carbocat-ions, and anions)
- Describe reaction mechanisms of organic reactions
- Explain product distribution and synthesis strategy
- Account for methods for the purification and isolation of organic chemicals
- Account for the influence of ionic strength (non-ideality) when doing calculations on chemical reactions in solution
- Explain the models for the structure of chemical complexation based on electron configuration

SKILLS

- Couple several chemical equilibria of both homogeneous and heterogeneous nature and to perform the necessary calculations for determination of the equilibrium state of the coupled system
- Explain various equilibrium diagrams with a particular focus on redox reactions
- Deduce important properties of chemical compounds using the periodic table of elements
- Apply the knowledge achieved in the course for analysis of the chemistry of a main group and other trends in the periodic table
- Apply the fundamental concepts of isotope and nuclear chemistry
- Use the nomenclature rules to read, interpret and disseminate information related to organic chemicals
- Write reaction mechanisms, stereochemistry and product distributions for selected ionic, organometallic and radical reactions
- Based on synthesis protocols, draw a block diagram showing all steps in the synthesis and the subsequent purification procedure

COMPETENCES

- Alter reaction pathways in order to achieve a preferred or particular outcome of a process
- Apply own knowledge of organic chemistry in technical, biological and ecological contexts

TYPE OF INSTRUCTION

- Lectures, laboratory exercises, theoretical exercises and workshops

EXTENT AND EXPECTED WORKLOAD

150 hours

EXAM

EXAMS

Name of exam	Inorganic and Organic Chemistry
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	Uorganisk og organisk kemi
Module code	K-KT-B3-3
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	Jens Muff

ORGANISATION

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

APPLIED STATISTICS

2018/2019

PREREQUISITE/RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

The module adds to the knowledge obtained in Linear Algebra and Calculus

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

LEARNING OBJECTIVES

KNOWLEDGE

Students who have passed the module should be able to

- Describe basic concepts of probability theory, statistics and quality control
- Account for relevant statistical software for solving problems in statistics and quality control

SKILLS

- Choose the right probability model and perform calculations according to the model. This applies to both discrete and continuous distributions
- Handle both one-dimensional as well as multi-dimensional random variables and the related distributions, discrete and continuous
- Calculate the mean, standard deviation for one-dimensional random variables and also be introduced into the calculation and understanding of covariance for multi-dimensional random variables
- Select the right statistical method and make calculations of confidence intervals and do hypothesis testing for one and two random samples, make analysis of variance and regression analysis in terms of continuous as well as discrete probability distributions
- Establish and solve problems in process control and product control, this applies both within continuous as an alternative variation
- Handle both traditional solution techniques as well as software based solutions
- Interpret the results obtained from the correct statistical method including their application
- Set up and use non-parametric tests on qualitative data

COMPETENCES

- Engage in a dialogue regarding the optimal choice of method within probability theory, statistics and quality control
- Disseminate the results of the calculations to others, including colleagues, public authorities, etc.

TYPE OF INSTRUCTION

- Lectures and theoretical exercises

EXTENT AND EXPECTED WORKLOAD

150 hours

EXAM

EXAMS

Name of exam	Applied Statistics
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	Anvendt statistik
Module code	K-KT-B3-30
Module type	Course
Duration	1 semester
Semester	Autumn
ECTS	5
Language of instruction	Danish
Empty-place Scheme	Yes
Location of the lecture	Campus Esbjerg
Responsible for the module	Poul Svante Eriksen

ORGANISATION

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

MATERIAL SCIENCE

2018/2019

PREREQUISITE/RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

The module adds to the knowledge obtained in:

Chemical and Bio Industrial Products II

Fundamental Chemical Engineering and Thermodynamics

Methods in Quantitative Chemical Analysis

Applied Statistics

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

LEARNING OBJECTIVES

KNOWLEDGE

Students who have passed the module should be able to

- Account for the fundamental structure and physical/chemical properties of materials
- Account for the production and application of materials
- Describe relevant methods for analysis and testing of materials

SKILLS

- Select relevant analytical methods and approaches for a given problem
- Conduct a series of experiments to gain information about key parameters
- Evaluate results from experiments using statistical methods
- Select materials to improve either a process or product
- Write a project report following the standards of the field of study, include relevant literature, use the correct terminology, and communicate the problem and results in writing, graphically and orally in a coherent way
- Justify the choice of methods, models and other tools used in the project and asses the problem of the project and results in relevant professional contexts

COMPETENCES

- Interpret and evaluate knowledge about materials
- Evaluate results from experimental work and their applicability to a given problem
- Handle the planning, implementation and management of a project and handle complex and development-oriented tasks during the project work and contribute to the project group's work and results
- Identify own learning needs for continued development and education in the field of study

TYPE OF INSTRUCTION

Project work

Access to perform laboratory experiments requires participation in laboratory safety instructions

EXTENT AND EXPECTED WORKLOAD

450 hours

EXAM

EXAMS

Name of exam	Material Science
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	Materialeteknologi
Module code	K-KT-B4-13
Module type	Project
Duration	1 semester
Semester	Spring
ECTS	15
Language of instruction	Danish and English
Empty-place Scheme	Yes
Location of the lecture	Campus Esbjerg
Responsible for the module	Morten Enggrob Simonsen
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

APPLIED MICROBIOLOGY

2018/2019

PREREQUISITE/RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

The module adds to the knowledge obtained in:

Chemical and Bio Industrial Products II

Chemical Analysis of Homogeneous Analysis

Methods in Quantitative Chemical Analysis

Applied Statistics

Microbial Biotechnology (in parallel)

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

LEARNING OBJECTIVES

KNOWLEDGE

Students who have passed the module should be able to

- Account for basic microbiology
- Account for basic security in relation to the handling of microorganisms and enzymes
- Describe reactor types that are relevant for Technical Microbiology, configurations thereof as well as their advantages and limitations
- Account for scale-up of microbiological processes including physical conditions and limitations
- Describe sterilization procedures and decimation time for microorganisms

SKILLS

- Demonstrate basic skills in practical methods for the characterization of microorganisms, substrates and products
- Select suitable microorganisms or enzymes to a specific technical problem
- Set up and solve relevant mass and energy balances for microbiological processes at laboratory scale and in technical scale
- Describe the necessary safety measures at all scale levels
- Account for proper waste management at all scale levels
- Account for suitable analytical methods for monitoring the microbiological process
- Construct an experimental setup equipped with appropriate data collection
- Analyze and interpret data from a fermentation process based on knowledge of the microorganism used
- Report data from the technical microbiological studies using proper statistical computing
- Write a project report following the standards of the field of study, include relevant literature, use the correct terminology, and communicate the problem and results in writing, graphically and orally in a coherent way
- Justify the choice of methods, models and other tools used in the project and asses the problem of the project and results in relevant professional contexts

COMPETENCES

- Provide technical microbiological knowledge to a broad range of people with different professional backgrounds
- Handle the planning, implementation and management of a project and handle complex and development-oriented tasks during the project work and contribute to the project group's work and results

- Identify own learning needs for continued development and education in the field of study

TYPE OF INSTRUCTION

Project work

Access to perform laboratory experiments requires participation in laboratory safety instructions

EXTENT AND EXPECTED WORKLOAD

450 hours

EXAM

EXAMS

Name of exam	Applied Microbiology
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	Teknisk Mikrobiologi
Module code	K-KT-B4-18
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	Jens Laurids Sørensen
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

PETROCHEMICAL SEPARATION PROCESSES

2018/2019

PREREQUISITE/RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

The module adds to the knowledge obtained in:

Chemical and Bio Industrial Products II

Fundamental Chemical Engineering and Thermodynamics

Methods in Quantitative Chemical Analysis

Applied Statistics

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

LEARNING OBJECTIVES

KNOWLEDGE

Students who have passed the module should be able to

- Describe the fundamental separation technologies used in production of oil and gas
- Account for the fundamental aspects of oil and gas production
- Account for fundamental types of calculations related to the separation of oil and gas
- Explain fundamental knowledge thermodynamics related to oil and gas separation

SKILLS

- Perform relevant calculations relating to oil and gas separation
- Design a separation train for a given production
- Evaluate which types of material are appropriate for the construction of the separation units
- Set specifications for a unit design based on the process in question
- Select an appropriate separation process for a given process
- Write a project report following the standards of the field of study, include relevant literature, use the correct terminology and communicate the problem and results in writing, graphically and orally in a coherent way
- Justify the choice of methods, models and other tools used in the project and asses the problem of the project and results in relevant professional contexts

COMPETENCES

- Evaluate the effectiveness and applicability of different separation methods in oil and gas technology
- Handle the planning, implementation and management of a project and handle complex and development-oriented tasks during the project work and contribute to the project group's work and results
- Identify own learning needs for continued development and education in the field of study

TYPE OF INSTRUCTION

Project work

Access to perform laboratory experiments requires participation in laboratory safety instructions

EXTENT AND EXPECTED WORKLOAD

450 hours

EXAM

EXAMS

Name of exam	Petrochemical Separation Processes
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	Petrokemiske separationsprocesser
Module code	K-KT-B4-19
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	Rudi Pankratz Nielsen
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

CHEMICAL THERMODYNAMICS AND SEPARATION PROCESS ENGINEERING

2018/2019

PREREQUISITE/RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

The module adds to the knowledge obtained in:

Chemical and Bio Industrial Products II

Fundamental Chemical Engineering and Thermodynamics

Inorganic and Organic Chemistry

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

LEARNING OBJECTIVES

KNOWLEDGE

Students who have passed the module should be able to

- Account for models for non-ideal gasses
- Explain theoretical and empirical models for phase equilibrium of pure species
- Account for mixtures, including partial properties, chemical potentials, fugacity, activity, coefficient of activity and must know models for phase equilibrium in mixtures
- Explain the theory and design of industrial separation processes, especially staged equilibrium processes as distillation, absorption and extraction
- Explain the functioning of separation process equipment used in chemical equilibrium processes

SKILLS

- Differentiate between ideal and non-ideal gasses and to use simple models of non-ideal gasses
- Write equation for thermodynamic equilibrium in ideal and in non-ideal mixtures and solutions
- Evaluate if a given chemical mixture can be separated and which methods could be applicable
- Use thermodynamic data to dimension simple equilibrium processes
- Write and use mass, energy and equilibrium relations to find the required number of equilibrium stages for a given separation of a binary mixture

COMPETENCES

- Describe, model and solve problems in separation process engineering

TYPE OF INSTRUCTION

Lectures and theoretical exercises

EXTENT AND EXPECTED WORKLOAD

150 hours

EXAM

EXAMS

Name of exam	Chemical Thermodynamics and Separation Process Engineering
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	Fysisk-kemiske separationsprocesser
Module code	K-KT-B4-3
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	Rudi Pankratz Nielsen

ORGANISATION

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

MICROBIAL BIOTECHNOLOGY

2018/2019

PREREQUISITE/RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

The module adds to the knowledge obtained in:

Biological Active Molecules – Introduction to Cell Biology and Biological Chemistry

General Chemistry

Inorganic and Organic Chemistry

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

LEARNING OBJECTIVES

KNOWLEDGE

Students who have passed the module should be able to

- Describe the cell as a biological entity
- Account for prokaryotic and eukaryotic cell structures
- Account for energy conversion in microorganisms
- Describe biochemical analysis methods
- Describe technically important microorganisms, their nutrition, metabolism and growth
- Account for microbial genetics
- Describe microbiological analysis methods
- Explain good microbiological practice

SKILLS

- Establish and calculate growth curves for microbiological growth
- Perform biochemical and microbiological tests in the laboratory in a safe way
- Handle experimental work with microorganisms, evaluate and use appropriate protective measures, work with sterile techniques, use relevant sources of information, and dispose of waste according to regulations

COMPETENCES

- Utilize knowledge on biochemical molecules, processes and systems, for projects in technical microbiology, food technology or for biotechnology development or production

TYPE OF INSTRUCTION

Lectures and theoretical exercises

EXTENT AND EXPECTED WORKLOAD

150 hours

EXAM

EXAMS

Name of exam	Microbial Biotechnology
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	Mikrobiel bioteknologi
Module code	K-KT-B4-4
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	Jens Laurids Sørensen

ORGANISATION

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

MATERIAL SCIENCE AND MATERIAL SELECTION

2018/2019

PREREQUISITE/RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

The module adds to the knowledge obtained in:

Linear Algebra

Calculus

Fundamental Chemical Engineering and Thermodynamics

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

LEARNING OBJECTIVES

KNOWLEDGE

Students who have passed the module should be able to

- Explain the fundamental structure and properties of metals, polymers, ceramics and composites
- Account for equilibrium and non-equilibrium diagrams
- Account for the selection of materials
- Account for material processing, including joining and surface treatment
- Explain the fundamental mechanisms in corrosion and wear/abrasion
- Describe material testing and the applicability of results gained from testing

SKILLS

- Carry out a material selection and select an appropriate processing method for such material
- Identify materials through acquired methods for material testing
- Evaluate if a material is suitable for a given purpose based on the properties of the material
- Select materials for a given application
- Select a processing method and method for joining of materials if required

COMPETENCES

- Evaluate the properties and applicability of a given material for engineering purposes
- Evaluate if a material will be subject to chemical or mechanical degradation in a given environment, and if needed subsequently select an appropriate surface treatment or substitution of the material

TYPE OF INSTRUCTION

Lectures and theoretical exercises

EXTENT AND EXPECTED WORKLOAD

150 hours

EXAM

EXAMS

Name of exam	Material Science and Material Selection
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	Materialelære og materialevalg
Module code	K-KT-B4-5
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	Morten Enggrob Simonsen

ORGANISATION

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

CHEMICAL PROCESS ENGINEERING

2018/2019

PREREQUISITE/RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

The module adds to the knowledge obtained in Chemical and Bio Industrial Products II

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

LEARNING OBJECTIVES

KNOWLEDGE

Students who have passed the module should be able to

- Describe the industrial or application context, in which the project work is included in, or may affect
- Describe general aspects of process engineering
- Explain the main unit operations in the process relating to the project work

SKILLS

- Determine which unit operation or reactor type is suitable in a given case
- Set specifications for process equipment for a given chemical process
- Analyze, model or size a selected process unit
- Perform relevant calculations for a given process
- Set up mass and energy balances for a given process
- Evaluate the effect of changing parameters for a given process
- Evaluate the potential of the project for further development, assessing and incorporating relevant economic factors
- Write a project report following the standards of the field of study, include relevant literature, use the correct terminology, and communicate the problem and results in writing, graphically and orally in a coherent way
- Justify the choice of literature, methods, models and other tools used in the project and asses the problem of the project and results in relevant professional and social contexts and in relation to literature

COMPETENCES

- Propose relevant laboratory experiments to allow for better modelling of a process
- Evaluate if changes to a given process could be beneficial
- Propose a course of action regarding a given process
- Evaluate the quality of experimental data obtained and their applicability to a model of a given process
- Handle the planning, implementation and management of a project and handle complex and development-oriented tasks during the project work and contribute to the project group's work and results
- Identify own learning needs for continued development and education in the field of study

TYPE OF INSTRUCTION

Project work

EXTENT AND EXPECTED WORKLOAD

450 hours

EXAM

EXAMS

Name of exam	Chemical Process Engineering
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	Kemisk procesteknologi
Module code	K-KT-B5-14
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	Rudi Pankratz Nielsen
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

BIOPROCESS ENGINEERING

2018/2019

PREREQUISITE/RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

The module adds to the knowledge obtained in: Chemical and Bio Industrial Products, Microbial Biotechnology II, Chemical Thermodynamics and Separation Processes and Chemical Reaction Engineering is Followed Simultaneously

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

LEARNING OBJECTIVES

KNOWLEDGE

Students who have passed the module should be able to

- Describe the industrial or application context, in which the project work is included in, or may affect
- Account for general aspects of process engineering
- Describe the main unit operations in the process relating to the project work

SKILLS

- Determine which unit operation or reactor type is suitable in a given case
- Set specifications for process equipment for a given chemical process
- Analyze, model or size a selected process unit
- Perform relevant calculations for a given process
- Set up mass and energy balances for a given process
- Evaluate the effect of changing parameters for a given process
- Evaluate the potential of the project for further development, assessing and incorporating relevant economic factors
- Propose relevant laboratory experiments to allow for better modelling of a process
- Write a project report following the standards of the field of study, include relevant literature, use the correct terminology, and communicate the problem and results in writing, graphically and orally in a coherent way
- Justify the choice of literature, methods, models and other tools used in the project and asses the problem of the project and results in relevant professional and social contexts and in relation to literature

COMPETENCES

- Evaluate if changes to a given process could be beneficial
- Propose a course of action regarding a given process
- Evaluate the quality of experimental data obtained and their applicability to a model of a given process
- Handle the planning, implementation and management of a project and handle complex and development-oriented tasks during the project work and contribute to the project group's work and results
- Identify own learning needs for continued development and education in the field of study

TYPE OF INSTRUCTION

- Project work

EXTENT AND EXPECTED WORKLOAD

450 hours

EXAM

EXAMS

Name of exam	Bioprocess Engineering
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	Bioprocesteknologi
Module code	K-KT-B5-15
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	Rudi Pankratz Nielsen
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

REFINERY PRODUCTS AND PROCESSES

2018/2019

PREREQUISITE/RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

The module adds to the knowledge obtained in Chemical and Bio Industrial Products II

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

LEARNING OBJECTIVES

KNOWLEDGE

Students who have passed the module should be able to

- Account for crude oil production
- Account for the composition of crude oil
- Describe the general structure of an oil refinery
- Explain the main refinery processes such as distillation, cracking and desulphurization
- Describe a given refinery process

SKILLS

- Perform relevant calculations for a given refinery process
- Set up mass and energy balances for a given refinery process
- Evaluate the effect of changing parameters for a given refinery process
- Evaluate the potential of the project for further development, assessing and incorporating relevant economic factors
- Propose relevant laboratory experiments to allow for better modelling of a process
- Write a project report following the standards of the field of study, include relevant literature, use the correct terminology, and communicate the problem and results in writing, graphically and orally in a coherent way
- Justify the choice of literature, methods, models and other tools used in the project and asses the problem of the project and results in relevant professional and social contexts and in relation to literature

COMPETENCES

- Evaluate if changes to a given process could be beneficial
- Propose a course of action regarding a given process
- Evaluate the quality of experimental data obtained and their applicability to a model of a given refinery process
- Handle the planning, implementation and management of a project and handle complex and development-oriented tasks during the project work and contribute to the project group's work and results
- Identify own learning needs for continued development and education in the field of study

TYPE OF INSTRUCTION

- Project work

EXTENT AND EXPECTED WORKLOAD

450 hours

EXAM

EXAMS

Name of exam	Refinery Products and Processes
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	Raffinaderiprodukter og processer
Module code	K-KT-B5-16
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	Rudi Pankratz Nielsen
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

CHEMICAL REACTION ENGINEERING

2018/2019

PREREQUISITE/RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

Fundamental Chemical Engineering and Thermodynamics, General Chemistry, Inorganic and organic chemistry

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

LEARNING OBJECTIVES

KNOWLEDGE

Students who have passed the module should be able to

- Explain fundamental concepts of chemical reaction engineering
- Account for ideal and non-ideal chemical reactors and reactor systems
- Describe the development of kinetic models on the basis of chemical reaction mechanisms
- Explain how reactor design and process conditions can be used to optimize yield and product distribution
- Explain the principles for catalysis and catalytic reactions
- Describe the reaction systems for major chemical and biotechnological products

SKILLS

- Analyze kinetic data from ideal reactors
- Set up rate equations for chemical and biochemical reactions based on knowledge of reaction mechanisms
- Set up and test rate equations from kinetic data
- Set up and solve equations for analysis and design of ideal reactors or reactor systems operating isothermally or adiabatically
- Optimize yield and selectivity of multiple reactions
- Model and analyze reactors for chemical or biochemical industrial reactions

COMPETENCES

- Apply the knowledge of kinetics and reactor design to the modelling systems for e.g. natural processes

TYPE OF INSTRUCTION

- Lectures and theoretical exercises

EXTENT AND EXPECTED WORKLOAD

150 hours

EXAM

EXAMS

Name of exam	Chemical Reaction Engineering
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	Kemisk reaktionsteknik
Module code	K-KT-B5-4
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	Marco Maschietti

ORGANISATION

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

HEAT TRANSFER AND FLUID MECHANICS

2018/2019

PREREQUISITE/RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

The module adds to the knowledge obtained in Fundamental Chemical Engineering and Thermodynamics.

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

LEARNING OBJECTIVES

KNOWLEDGE

Students who complete the module must be able to:

- account for fundamental thermodynamics, fluid mechanics and heat transfer
- account for fundamental thermodynamics
- account for fundamental fluid mechanics
- account for fundamental convection
- account for heat transfer in thermal networks
- account for heat exchangers

SKILLS

Students who complete the module must be able to:

- apply thermodynamics to solve engineering problems
- use the energy equation on flow in piping with different components such as pumps, valves, bends and nozzles
- use fundamental fluid mechanics to analyse external flow around objects
- calculate heat transfer in thermal networks
- calculate heat transfer coefficients both at external and at internal surfaces
- analyze and select heat exchangers

COMPETENCES

Students who complete the module must be able to:

- apply the acquired knowledge and skills to describe, model and solve problems in process engineering project.
- to communicate problems and solutions to people without thorough knowledge of the subject.

TYPE OF INSTRUCTION

Lectures and theoretical exercises.

EXTENT AND EXPECTED WORKLOAD

The module is 5 ECTS which is corresponding to 150 hours of study.

EXAM

EXAMS

Name of exam	Heat Transfer and Fluid Mechanics
Type of exam	Written and oral exam

	Written examination.
ECTS	5
Assessment	7-point grading scale
Type of grading	Internal examination
Criteria of assessment	As stated in the Joint Programme Regulations. https://www.en.engineering.aau.dk/digitalAssets/346/346123_joint_programme.pdf

FACTS ABOUT THE MODULE

Danish title	Varmetransmission og strømningsmekanik
Module code	B-MT-D5-11
Module type	Course
Duration	1 semester
Semester	Autumn
ECTS	5
Language of instruction	Danish and English
Location of the lecture	Campus Esbjerg
Responsible for the module	Lars Damkilde, Søren Heide Lambertsen

ORGANISATION

Study Board	Study Board of Civil Engineering
Department	Department of Civil Engineering
Faculty	Faculty of Engineering and Science

MATHEMATICAL MODELING AND NUMERICAL METHODS

2018/2019

PREREQUISITE/RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

Linear Algebra and Calculus

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

LEARNING OBJECTIVES

KNOWLEDGE

Students who have passed the module should be able to

- Account for basic modeling and analysis of certain ordinary and partial differential equations
- Account for basic analysis of the above ordinary and partial differential equations
- Account for basic concepts of numerical methods
- Explain numerically solving non-linear systems of equations, integrals, and ordinary and partial differential equations
- Account for the modeling and analysis of the above ordinary and partial differential equations

SKILLS

- Use extra- and interpolation techniques such as Taylor polynomials and Lagrange polynomials
- Use Laplace transforms to solve differential equations
- Apply vector analysis and integral principles for mathematical modeling
- Apply methods, analytical as well as numerical, to solve the above ordinary and partial differential equations
- Set up and use the correct numerical method for solving a variety of areas, such as finding the zero point, integration, interpolation, differential equations
- Set up and solve 1- and 2-dimensional heat equations by analytical and numerical methods
- Set up and solve 1- and 2-dimensional wave equations by analytical and numerical methods
- Set up and solve Poisson's and Laplace's equations by numerical methods
- Develop solutions of differential equations using systems of eigenfunctions
- Solve partial differential equations using Fourier series and the separation method

COMPETENCES

- Engage in a dialogue regarding the optimal choice of analytical and numerical solution methods for partial differential equations, and results from mathematical modeling in general
- Disseminate setup and results of solving certain partial differential equations to others, including colleagues, government agencies and others

TYPE OF INSTRUCTION

- Lectures and theoretical exercises

EXTENT AND EXPECTED WORKLOAD

150 hours

EXAM

EXAMS

Name of exam	Mathematical Modeling and Numerical Methods
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	Matematisk modellering og numeriske metoder
Module code	K-KT-B5-6
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	Morten Grud Rasmussen

ORGANISATION

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

DESIGN OF EXPERIMENTS

2018/2019

PREREQUISITE/RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

The module adds to the knowledge obtained in Applied Statistics

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

LEARNING OBJECTIVES

KNOWLEDGE

Students who have passed the module should be able to

- Explain the establishment of experimental design with qualitative and quantitative factors
- Account for complete, partial and confounding 2k and 3k factorial experiments
- Explain incomplete block design and splitplot designs
- Explain how to perform control experiments, including the use of central points
- Account for orthogonal experimental design
- Describe methods of optimization of the experimental factors and minimizing noise factors
- Account for regression analysis (including step-wise regression) of the drop in data
- Explain response surface design

SKILLS

- Develop study plans with qualitative and quantitative factors
- Perform control experiments
- Optimize the experimental factors
- Minimize the noise factors
- Use multiple analysis of variance and regression analyzes, including the combined variance and regression analyzes
- Analyze experimental data and be able to evaluate the methods used, validity and usefulness
- Use statistical design of experiments in practice within the domain of quality / process optimization and to process the results by statistical methods on a computer

TYPE OF INSTRUCTION

Lectures and theoretical exercises

EXTENT AND EXPECTED WORKLOAD

150 hours

EXAM

EXAMS

Name of exam	Design of Experiments
Type of exam	Oral exam Based on a prepared mini project
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	Statistisk forsøgsplanlægning
Module code	K-KT-B6-6
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	Sergey Kucheryavskiy

ORGANISATION

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

PROCESS CONTROL, INSTRUMENTATION AND SAFETY

2018/2019

PREREQUISITE/RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

The module adds to the knowledge obtained in:

Mathematical Modeling and Numerical Methods

Fundamental Fluid Mechanics and Heat Transfer

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

LEARNING OBJECTIVES

KNOWLEDGE

Students who have passed the module should be able to

- Account for diagrams and system interconnections
- Explain modeling of physical systems, determination of operating points and linearization
- Explain a system's dynamic and stationary behavior, including the effects of the type and order of the system, as well as poles and zero points and their impact on the response of the system
- Account for analysis by root curves and knowledge of controller design using root curves
- Account for a system's frequency response (open-loop and closed - loop)
- Account for stability analyses
- Describe design using frequency response techniques
- Explain analog implementation of controllers
- Describe measurement techniques and data collection using a PC
- Account for software for building/developing applications for data acquisition and control
- Account for the structure and operation of the measurement system including sensors, signal processing and monitoring system
- Explain the operation of classical sensors (pressure, temperature, position, velocity, acceleration and flow)
- Account for sampling, different connections and noise from measurements

SKILLS

- Analyze block diagrams on the basis of PI – charts
- Model and analyze basic dynamical systems, including electrical, mechanical and thermal systems and analogies between these
- Develop models of dynamic systems in the form of transfer functions
- Apply control theory to achieve performance criteria
- Analyze a system's response and stability using the classical methods
- Select appropriate regulators and predict/assess their impact
- Use standard software for data acquisition, control and regulation
- Connect classical sensors and conduct research with classical sensors for pressure, temperature, position, velocity, acceleration and flow
- Assess the quality of the measurements and apply appropriate processing on them
- Disseminate the problem, the used solution method and interpret the outcome

TYPE OF INSTRUCTION

Lectures and theoretical exercises

EXTENT AND EXPECTED WORKLOAD

150 hours

EXAM

EXAMS

Name of exam	Process Control, Instrumentation and Safety
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	Procesregulering, instrumentering og sikkerhed
Module code	K-KT-B6-7
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	Sergey Kucheryavskiy

ORGANISATION

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

PROJEKTLEDELSE OG ØKONOMI

2018/2019

MODULETS INDHOLD, FORLØB OG PÆDAGOGIK

LÆRINGSMÅL

VIDEN

Studerende, der gennemfører modulet, skal kunne:

- Redegøre for økonomiske vilkår for bygge- og anlægsbranchen
- Redegøre for budgettering, bogføring og budgetanalyse
- Redegøre for drifts-, investerings- og finansieringsmæssige kalkuler
- Redegøre for generelle projektledelsesmodeller og entreprenørskab
- Redegøre for grundlæggende projektplanlægningsværktøjer såsom tids- og ressourceplaner
- Redegøre for generelle organisations-, motivations-, kommunikations- og entreprenørskabsteorier
- Redegøre for arbejdsmiljø, sikkerhed og sundhed på byggeprojekter

FÆRDIGHEDER

- Anvende sædvanlige metoder til kalkulation af omkostninger i produktionsvirksomheder
- Anvende sædvanlige metoder til vurdering af investerings fordelagtighed samt til finansieringen af disse aktiviteter
- Forklare almindelige hændelsers bogmæssige posteringer
- Analysere regnskaber og på grundlag heraf vurdere den økonomiske situation
- Argumentere for sædvanlige modeller for motivation, kommunikation og ledelse og anvende modellerne på mindre komplekse cases
- Forklare traditionelle modeller for organisering af bygge- og anlægsprojekter samt mere moderne samarbejdsformer i sådanne projekter
- Udforme relevante tids- og ressourceplaner ud fra principperne bag lean construction
- Forklare begreber og metoder der bruges i ledelse af arbejdsmiljøarbejdet på en byggeplads
- Vurdere konkrete cases med henblik på deres anvendelse af konkrete arbejdsmiljømæssige redskaber

KOMPETENCER

- Redegøre for projektaktiviteters indvirkning på de økonomiske posteringer samt de styringsmæssige opgaver i projektledelsen
- Redegøre for det økonomiske og ledelsesmæssige rationale i at arbejde aktivt med arbejdsmiljø

UNDERVISNINGSFORM

Forelæsninger og teoretiske øvelser

OMFANG OG FORVENTET ARBEJDSINDSATS

150 timer

EKSAMEN

PRØVER

Prøvens navn	Projektledelse og økonomi
Prøveform	Skriftlig eller mundtlig
ECTS	5

Bedømmelsesform	Bestået/ikke bestået
Censur	Intern prøve
Vurderingskriterier	Er angivet i fællesbestemmelserne

FAKTA OM MODULET

Engelsk titel	Project Management and Economics
Modulkode	K-KT-D6-3
Modultype	Kursus
Varighed	1 semester
Semester	Forår
ECTS	5
Undervisningssprog	Dansk
Tomplads	Ja
Undervisningssted	Campus Esbjerg
Modulansvarlig	Morten Enggrob Simonsen

ORGANISATION

Studienævn	Studienævnet for Kemi, Miljø og Bioteknologi
Institut	Institut for Kemi og Biovidenskab
Fakultet	Det Ingeniør- og Naturvidenskabelige Fakultet

DIPLOMINGENIØRPRAKTIK

2018/2019

FORUDSÆTNINGER/ANBEFALEDE FORUDSÆTNINGER FOR AT DELTAGE I MODULET

Praktikken bygger videre på viden opnået i alle moduler til og med 5. semester

MODULETS INDHOLD, FORLØB OG PÆDAGOGIK

LÆRINGSMÅL

VIDEN

Studerende, der gennemfører modulet, skal kunne:

- Redegøre for en virksomheds organisation og arbejde set ud fra en ingeniørmæssig synsvinkel
- Redegøre for sammenhængen mellem teori på uddannelsen og praksis

FÆRDIGHEDER

- Analysere om professionen har nye faglige behov der bør/kan varetages af uddannelsen
- Vurdere om læringsmålene for praktikken er blevet opfyldt

KOMPETENCER

- Analysere det faglige, arbejdsmæssige som det sociale udbytte af praktikopholdet
- Håndtere udviklingsorienterede situationer i studie- eller arbejdssammenhænge

UNDERVISNINGSFORM

Praktikken afvikles i sidste del af 6. semester og første del af 7. semester og følger retningslinjerne angivet i ”SES-procedure for praktik” og ”Retningslinjer for diplomingeniørpraktik”, tillæg til fællesbestemmelserne. Det konkrete tidspunkt for opstart af praktikken meddeles særskilt

OMFANG OG FORVENTET ARBEJDSINDSATS

900 timer

EKSAMEN

PRØVER

Prøvens navn	Diplomingeniørpraktik
Prøveform	Mundtlig pba. projekt Prøven er på baggrund af skriftlig praktikrapport, dagbogen samt udtalelsen fra praktik-vejlederen
ECTS	30
Bedømmelsesform	Bestået/ikke bestået
Censur	Ekstern prøve
Vurderingskriterier	Er angivet i fællesbestemmelserne

FAKTA OM MODULET

Engelsk titel	Internship for Bachelors of Engineering
Modulkode	K-KT-D6-5
Modultype	Projekt
Semester	Forår
ECTS	30
Undervisningssprog	Dansk
Undervisningssted	Campus Esbjerg
Modulansvarlig	Morten Enggrob Simonsen
Censornorm	C

ORGANISATION

Studienævn	Studienævnet for Kemi, Miljø og Bioteknologi
Institut	Institut for Kemi og Biovidenskab
Fakultet	Det Ingeniør- og Naturvidenskabelige Fakultet

BACHELORPROJEKT I KEMI OG BIOTEKNOLOGI 2018/2019

MODULETS INDHOLD, FORLØB OG PÆDAGOGIK

LÆRINGSMÅL

VIDEN

Studerende, der gennemfører modulet, skal kunne

- Redegøre for udviklingsbaseret viden om faglig praksis og anvende teorier og metoder inden for kemi og bioteknologi

FÆRDIGHEDER

- Opbygge en projektrapport efter fagområdets normer, inddrage relevant litteratur, benytte korrekt fagsprog og formidle projektets problemstilling og resultater skriftligt, grafisk og mundtligt på en sammenhængende måde
- Begrunde valg af litteratur, metoder, modeller og andre redskaber benyttet i projektarbejdet samt vurdere projektets problemstilling og resultater i relevant faglig, samfundsmæssig og teoretisk kontekst samt i relation til faglitteraturen

KOMPETENCER

- Varetage planlægning, gennemførsel og styring af et projekt og håndtere komplekse og udviklingsorienterede opgaver under projektarbejdet og selvstændigt bidrage til projektgruppens arbejde og resultater
- Identificere egne læringsbehov for fortsat udvikling og videreuddannelse indenfor fagområdet

UNDERVISNINGSFORM

- Projektarbejde

OMFANG OG FORVENTET ARBEJDSINDSATS

450 timer

EKSAMEN

PRØVER

Prøvens navn	Bachelorprojekt i kemi og bioteknologi
Prøveform	Mundtlig pba. projekt
ECTS	15
Bedømmelsesform	7-trins-skala
Censur	Ekstern prøve
Vurderingskriterier	Er angivet i fællesbestemmelserne

FAKTA OM MODULET

Engelsk titel	BSc Project in Chemical Engineering and Biotechnology

Modulkode	K-KT-D7-5
Modultype	Projekt
Varighed	1 semester
Semester	Efterår
ECTS	15
Undervisningssprog	Dansk
Undervisningssted	Campus Esbjerg
Modulansvarlig	Morten Enggrob Simonsen
Censornorm	C

ORGANISATION

Studienævn	Studienævnet for Kemi, Miljø og Bioteknologi
Institut	Institut for Kemi og Biovidenskab
Fakultet	Det Ingeniør- og Naturvidenskabelige Fakultet