Catalogue report

LUT School of Engineering Science

Master's Programme in Chemical Engineering and Water Treatment

Master’s Programme in Chemical Engineering and Water Treatment 2018-2019 (120 ECTS)

Facts

• Degree Master of Science in Technology (M.Sc. Tech.), (Diplomi-insinööri in Finnish)
• Higher university degree, gives eligibility to apply for scientific doctoral studies
• Extent 120 ECTS credits
• Duration two years, full-time studies of 60 ECTS per academic year.

Learning Outcomes of the Programme

After completion of the MSc programme in Chemical Engineering and Water Treatment, the graduate specialising in Chemical and Process Engineering
• has solid theoretical background in core areas of chemical engineering
• has strong engineering analysis and problem solving skills
• has trained engineering practice skills such as making approximations and decisions under uncertainty
• has the courage to create innovations and new technical solutions
• possesses project working and communication skills needed in the modern working environment.

After completion of the MSc programme in Chemical Engineering and Water Treatment, the graduate specialising in Water Treatment
• has a comprehensive understanding of the BAT and future water treatment technologies, covering advanced oxidation and various separation methods
• is able to demonstrate a broad knowledge in process and environmental analytics and monitoring
• has adopted the principles of sustainability in the water treatment
• is able to demonstrate a critical understanding of relevant theories and techniques, problem-solving skills, and ability to independently use knowledge, equipment and tools for the design and development of practical water treatment applications.
• is able to work with others in task-orientated groups participating and interacting in the group in a productive manner
• is able to logically think through a problem and solve it.

Degree Structure

The students of the Master’s Programme in Chemical Engineering and Water Treatment specialise either in Chemical and Process Engineering or in Water treatment.
The Master's degree (120 ECTS) consists of core studies, specialisation studies, minor studies and free elective studies. The Master's Thesis and Seminar is included in the specialisation studies.

This MSc is also available as a Double Degree Programme for the students of the partner universities of LUT. The Double Degree Programme has a separate degree structure of its own.

See Uni-portal:
https://uni.lut.fi/en/web/lut.fi-eng/chemical-engineering

Degree structures

Degree Structure

The Master's degree (120 ECTS) consists of core studies, specialisation studies, minor studies and free elective studies.

The students of the Master’s Programme in Chemical Engineering and Water Treatment specialise either in Chemical and Process Engineering or in Water treatment. The Master's Thesis and Seminar is included in the specialisation studies.

The MSc in Chemical Engineering and Water Treatment has recommendations on how the students should choose the minor:
KeSoD200 Advanced Water Treatment (not for students specialising in Water Treatment)
KeSoD300 Advanced Process Engineering (not for students specialising in Chemical and Process Engineering)
KeSoD400 Biobased Chemical Engineering (suitable for distance learning)
KeSoD500 Advanced Chemistry.

Electives can be any courses offered by LUT if the required prerequisites are fulfilled. Studies in other domestic or foreign higher education institutions, a max. of 10 ECTS of internship (BJ02A0031 Work Internship in Master's Degree, 2-10 ECTS) or the leadership training provided by the National Forces (Puolustusvoimien johtajakoulutus) may be included in the degree by application. The s tudies are approved by the Head of degree programme.

This MSc is also available as a Double Degree Programme for the students of the partner universities of LUT. The Double Degree Programme has a separate degree structure of its own.

Master's Programme in Chemical Engineering and Water Treatment 2018-2019

Degree structure status: accepted

Academic year: 2018-19

Beginning date of the academic year: 01.08.2018

Core Studies

Students admitted directly to this M.Sc. programme have to take Orientation to M.Sc. Studies, 1 ECTS, and the amount of core studies is 1 ECTS. Students continuing from the B.Sc. of LUT to this M.Sc. programme do not have to take any core studies.

BJ02A0050: Orientation to M.Sc. Studies, 1 cr

Specialisation Studies (min 80 cr)

Choose either Specialisation in Chemical and Process Engineering or Specialisation in Water Treatment.

Specialisation in Chemical and Process Engineering

KeDCaPESpec: Specialisation in Chemical and Process Engineering, 81 cr
Obligatory specialisation studies, 81 ECTS.
BJ02A1100: Biorefineries, 5 cr
BJ02A2011: Modelling of Unit Operations, 5 cr
BJ02A2000: Knowledge Discovery and Process Data Analysis, 5 cr
BJ02A2030: Fluid Dynamics in Chemical Engineering, 5 cr
BJ02A2041: Advanced Process Design, 5 cr
BJ02A2051: Process Intensification, 5 cr
BJ02A2061: Product Design, 5 cr
BJ02A2070: Project on Process and Plant Design, 10 cr
BH50A1500: Bioenergy Technology Solutions, 6 cr
BJ02A0041: Master's Thesis and Seminar, 30 cr

Specialisation in Water Treatment

KeDWTSpec: Specialisation in Water Treatment, 80 cr
Obligatory specialisation studies, 80 ECTS.
BJ02A1090: Environmental and Industrial Analytics, 5 cr
BJ02A1031: Solution Chemistry, 5 cr
BJ02A3010: Membrane Technology, 5 cr
BJ02A3030: Solid-Liquid Separation, 5 cr
BJ03A1010: Introduction to Advanced Water Treatment, 5 cr
BJ03A1020: Biological Waste Water Treatment, 5 cr
BJ03A1040: Advanced Materials in Adsorption and Ion Exchange, 5 cr
BJ03A2010: Advanced Oxidation Processes & Electrochemical Methods in Water Treatment, 5 cr
BJ03A2040: Research Project Course in Water Treatment, 10 cr
BJ02A0041: Master's Thesis and Seminar, 30 cr

Minor Studies (min 20 cr)

Choose one of the following minors:
KeSoD200 Advanced Water Treatment (not for students specialising in Water Treatment)
KeSoD300 Advanced Process Engineering (not for students specialising in Chemical and Process Engineering)
KeSoD400 Biobased Chemical Engineering
KeSoD500 Advanced Chemistry.

Elective Studies

Choose enough courses to attain a min. of 120 ECTS in the M.Sc. degree. Electives can be any courses offered by LUT if the required prerequisites are fulfilled. Studies in other domestic or foreign higher education institutions, the leadership training provided by the National Defence Forces or internship (BJ02A0031 Work Internship in Master's Degree, a max. of 10 ECTS) can be included in the degree by application; the studies are approved by the Head of Degree Programme.

Master's Programme for Double Degree Students/Major in Chemical and Process Engineering 2018-2019

Degree structure status: accepted

Academic year: 2018-19

Beginning date of the academic year: 01.08.2018

Core Studies (min 1 cr)

Obligatory core studies of 1 ECTS.

BJ02A0050: Orientation to M.Sc. Studies, 1 cr

Specialisation Studies (min 69 cr)

The extent of specialisation studies for double degree students is a min. of 69 ECTS.

KeDDDSpec: Specialisation in Chemical and Process Engineering for double degree students, 69 - 81 cr
In addition to a Master's thesis, choose a min. of 39 ECTS of courses from the list below.
BJ02A2011: Modelling of Unit Operations, 5 cr
BJ02A2000: Knowledge Discovery and Process Data Analysis, 5 cr
BJ02A2030: Fluid Dynamics in Chemical Engineering, 5 cr
BJ02A2041: Advanced Process Design, 5 cr
BJ02A2051: Process Intensification, 5 cr
BJ02A2061: Product Design, 5 cr
BH50A1500: Bioenergy Technology Solutions, 6 cr
BJ02A1100: Biorefineries, 5 cr
BJ02A2070: Project on Process and Plant Design, 10 cr
BJ02A0041: Master's Thesis and Seminar, 30 cr

Elective Studies

Double degree students do not have to take any elective studies, as the Master's degree is filled with core studies (1 ECTS), specialisation studies (a min. of 69 ECTS) and credit transfer (50 ECTS).

Credit Transfer (max 50 cr)

A credit transfer (a max. of 50 ECTS) from the studies at student's home university can be added here.

Courses and study modules not included in degree structures

The MSc in Chemical Engineering and Water Treatment has recommendations on how the students should choose the minor:
KeSoD200 Advanced Water Treatment (not for students specialising in Water Treatment)
KeSoD300 Advanced Process Engineering (not for students specialising in Chemical and Process Engineering)
KeSoD400 Biobased Chemical Engineering (suitable for distance learning)
KeSoD500 Advanced Chemistry.

KeSoD500: Advanced Chemistry, 20 - 25 cr
Choose a min. of 20 ECTS
BJ02A1012: Concepts of Analytical and Inorganic Chemistry, 5 cr
BJ02A1600: Biobased Materials and Advanced Organic Chemistry, 5 cr
BJ02A1031: Solution Chemistry, 5 cr
BJ02A4070: Principles of Thermal Gas-Liquid Processes, 5 cr
BJ03A1040: Advanced Materials in Adsorption and Ion Exchange, 5 cr
KeSoD300: Advanced Process Engineering, 20 - 35 cr
Choose a min. of 20 ECTS.
BJ02A3010: Membrane Technology, 5 cr
BJ02A3021: Chemical Separation Methods, 5 cr
BJ02A3030: Solid-Liquid Separation, 5 cr
BJ02A2000: Knowledge Discovery and Process Data Analysis, 5 cr
BJ02A2061: Product Design, 5 cr
BJ02A3051: Hydrometallurgy, 5 cr
BJ02A4070: Principles of Thermal Gas-Liquid Processes, 5 cr
KeSoD200: Advanced Water Treatment, 20 - 25 cr
Choose a min. of 20 ECTS
BJ03A1010: Introduction to Advanced Water Treatment, 5 cr
BJ03A1020: Biological Waste Water Treatment, 5 cr
BJ03A1040: Advanced Materials in Adsorption and Ion Exchange, 5 cr
BJ03A2010: Advanced Oxidation Processes & Electrochemical Methods in Water Treatment, 5 cr
BJ02A3010: Membrane Technology, 5 cr
KeSoD400: Biobased Chemical Engineering, 20 - 30 cr
Choose a min. of 20 ECTS. This minor is suitable for distance learning.
BJ02A1090: Environmental and Industrial Analytics, 5 cr
BJ02A1100: Biorefineries, 5 cr
BJ02A1200: Bioeconomy, 5 cr
BJ02A1500: Current Issues in Enabling Technologies for Circular Economy, 5 cr
BJ02A1600: Biobased Materials and Advanced Organic Chemistry, 5 cr
BJ02A4070: Principles of Thermal Gas-Liquid Processes, 5 cr

Course descriptions

Descriptions of courses and study modules included in the degree structures

BJ02A0050: Orientation to M.Sc. Studies, 1 cr

Validity: 01.01.2017 -
Form of study: Basic studies
Type: Course
Unit: LUT School of Engineering Science
Grading: Study modules 0-5,P/F

Teachers: Ritva Tuunila

Note:
Teaching is organized jointly for all Master's Programmes in Chemical Engineering.
Year:
M.Sc. (Tech.) 1
Period:
1
Teaching Language:
English
Teacher(s) in Charge:
Associate Professor, D.Sc. (Tech) Ritva Tuunila
Aims:
After completing the course, the student - is familiar with the formal requirements of his/her studies and with the campus services and their appropriate use during his/her studies - is aware of information security issues - possesses good practices for safe laboratory working.
Contents:
During the course the student will learn about the relevant instructions affecting his/her studies and how to generate a personal study plan. The student will familiarize him/herself with the relevant staff of his/her degree programme and with the services provided by e.g. the Library and Study Services. The student will learn about the relevant laboratory safety instructions.
Teaching Methods:
Lectures 6 h, independent assignments 10 h, self-study 10 h. Total workload 26 h.
Examination in Examination schedule (Yes/No):
No
Examination in Moodle (Yes/No):
No
Examination in Exam (Yes/No):
No
Assessment:
Pass/fail. After completing the course assignments acceptably, the student passes the course.
Course Materials:
Moodle material
Places for exchange-students? (Yes, number/No):
No
Places for Open University Students?(Yes, number/No):
max 5

KeDCaPESpec: Specialisation in Chemical and Process Engineering, 81 cr

Validity: 01.08.2018 -

Form of study:

Type: Study module

Unit: LUT School of Engineering Science

Grading: Study modules 0-5,P/F

No course descriptions.

Obligatory specialisation studies, 81 ECTS.

BJ02A1100: Biorefineries, 5 cr

Validity: 01.01.2018 -

Form of study: Basic studies

Type: Course

Unit: LUT School of Engineering Science

Grading: Study modules 0-5,P/F

Note:

The course is suitable for distance learning.
This course is mainly directed to the students in the digital Master's Programme in Biorefineries.

Year:

M.Sc. (Tech.) 1

Period:

3

Teaching Language:

English

Teacher(s) in Charge:

Associate professor, D.Sc. (Tech.) Eeva Jernström

Aims:

By the end of the course, the student is expected to be able to
- Understand the basic concept of a biorefinery and the various alternative concepts
- Understand the main biorefining processes, e.g. kraft pulp process, production of biofuels, further processing of different bio-based raw materials.
- Have general knowledge of current biorefinery products, their applicability to different end-uses
- Apply management and cooperation skills in implementation of project work in combined virtual and f2f working environment.

Contents:

The course covers the most typical biorefining-processes currently in use as well as some selected future processes. Topics include raw materials for biorefineries, processes and process conditions, most common biorefinery products and their end-uses. The course includes Moodle assignments and project work. The project work will be carried out individually or in small groups that will define their own target, and working methodology. The course is suitable for distance learning.

Teaching Methods:

Tutorials and workshops 5 h, 2nd period. Project work 50 h. Self Study of predefined material 75 h. Total workload 130 h.
The course includes Moodle assignments and project work. The project work will be carried out individually or in small groups that will define their own target, and working methodology

Examination in Examination schedule (Yes/No):

No

Examination in Moodle (Yes/No):

No

Examination in Exam (Yes/No):

No

Assessment:

0-5, Moodle assignments 60 %, Project work 40 %.

Course Materials:

Will be announced later.

Limitation for students? (Yes, number, priorities/Leave empty):

Yes, this course is mainly directed to the students in the digital Master's Programme in Biorefineries.

Places for exchange-students? (Yes, number/No):

No

Places for Open University Students?(Yes, number/No):

max 5

BJ02A2011: Modelling of Unit Operations, 5 cr

Validity: 01.01.2017 -
Form of study: Basic studies
Type: Course
Unit: LUT School of Engineering Science
Grading: Study modules 0-5,P/F
Teachers: Tuomo Kauranne, Dipal Shah

Year:

M.Sc. (Tech.) 1, M.Sc. (Tech.) 2

Period:

2

Teaching Language:

English

Teacher(s) in Charge:

Associate professor, Ph.D. Tuomo Kauranne

Aims:

After completing the module the student - can describe steady-state and transient unit operations with mathematical models - can validate models and estimate parameters from experimental data - can apply phenomenon based models in process development and design
tasks, such as sizing, optimization, and scale-up - can use mathematical and simulation software.

Contents:

Modeling and parameter estimation in Matlab, for Chemical Engineering and Applied Mathematics in general. The course presents kinetic models for processes that feature chemical reactions, temperature dependence, CSTR and batch reactors with and without cooling, plug flow and pipeline reactors.

Teaching Methods:

Lectures 24 h, exercises 14 h, 2nd period. Home assignments 70 h, self-study 22 h. Home assignments passed, no exam.
Total workload 130 h.

Suitability for doctoral studies (Yes/Leave empty):

Yes

Examination in Examination schedule (Yes/No):

No

Examination in Moodle (Yes/No):

No

Examination in Exam (Yes/No):

No

Assessment:

0-5. Half of the grade is decided by the share of exercises completed by the student, the other half by the quality of the work and reports produced from home assignments.

Course Materials:

In Moodle.

Prerequisites:

Either the Finnish course Johdatus tekniseen laseknta an or Principles of Technical Computing, or corresponding skills in MATLAB programming.

Places for exchange-students? (Yes, number/No):

max 10

Places for Open University Students?(Yes, number/No):

max 10

BJ02A2000: Knowledge Discovery and Process Data Analysis, 5 cr

Validity: 01.08.2018 -

Form of study: Basic studies

Type: Course

Unit: LUT School of Engineering Science

Grading: Study modules 0-5,P/F

Note:

The course is suitable for distance learning.

Year:

M.Sc. (Tech.) 1

Period:

4

Teaching Language:

English

Teacher(s) in Charge:

Professor, D.Sc. (Tech.) Satu-Pia Reinikainen

Aims:

By the end of the course, the student is expected to
• Be aware of the effect of digitalization and automation on amount, nature, and quality of data from chemical engineering point of view
• have acquired a basic knowledge of the main concept of knowledge discovery process concerning industrial data
• be able to apply specified methods and methodology on data
• be able to apply management and cooperation skills in implementation of project work.

Contents:

The knowledge discovery is referring to the overall process of discovering useful knowledge from data. The knowledge discovery process is interactive and iterative and involves several steps starting from Learning the application domain and ending to Using the discovered Knowledge. Process data analysis can be part of the knowledge discovery process. Fundamental concepts - such as reliability of data, preprocessing (e.g., de-noising, deciding on strategies for handling missing data fields), data reduction, choosing methodology, validation, modelling, etc - will be addressed in tutorials, Moodle assignments, and discussions. The project work will be carried out in small groups that will define their own target, and working methodology. The course is suitable for distance learning.

Teaching Methods:

Online tutorials 7 h, online discussions and peer feedback 7 h, Moodle exams 7 h, and assignments 20 h. Project work 40 h, online independent study 49 h. Total workload 130 h.

Suitability for doctoral studies (Yes/Leave empty):

Yes

Examination in Examination schedule (Yes/No):

No

Examination in Moodle (Yes/No):

Yes

Examination in Exam (Yes/No):

No

Assessment:

Numerical assessment (0-5), Project work 40 %, assignments 30 %, Moodle exams and peer feedback 30 %.

Course Materials:

Tutorial videos, online material distributed or announced in Moodle.

Limitation for students? (Yes, number, priorities/Leave empty):

Yes, 50, Students in Chemical Engineering M.Sc. programme

Places for exchange-students? (Yes, number/No):

max 10

Places for Open University Students?(Yes, number/No):

max 10

BJ02A2030: Fluid Dynamics in Chemical Engineering, 5 cr

Validity: 01.08.2014 -
Form of study: Basic studies
Type: Course
Unit: LUT School of Engineering Science
Grading: Study modules 0-5,P/F
Teachers: Tuomas Koiranen

Year:

M.Sc. (Tech.) 1

Period:

3

Teaching Language:

English

Teacher(s) in Charge:

Professor, D.Sc. (Tech.) Tuomas Koiranen

Aims:

A student can: - Select, size and scale-up different mixing devices (stirred tanks, in-line mixers) for blending and multiphase mixing (solid-liquid mixing, liquid and gas dispersions) based on short-cut design methods. - Understand basics of fluid rheology and adapt the
information to mixing design. - Understand computational fluid dynamics (CFD) calculations and is able to solve basic fluid mixing problems with CFD programs.

Contents:

Design methods and scale-up of fluid mixers, rheology, mixing effects in chemical reactions. Theoretical basis of CFD and chemical engineering aspects.

Teaching Methods:

Exercise based lecturing 18 h, home exercises 32 h (in Moodle), fluid mixing demonstration 4 h and /or mixing case study (design work) 27 h, seminar 8 h, 3rd period. Self-study 41 h.
Total workload 130 h.

Examination in Examination schedule (Yes/No):

No

Examination in Moodle (Yes/No):

No

Examination in Exam (Yes/No):

No

Assessment:

0-5, 75% home exercises for passing course, 100% home exercises increases grade 20%.
Mixing case study report (failed/satisfactory/good). Good report increases grade 20%.
Examination 60% (exam grade at least 1 for passing course).

Course Materials:

Additional material will be informed at lectures. Material in Moodle.

Prerequisites:

BH40A1400 Virtaustekniikka I (Fluid Dynamics I) or equivalent passed, BM20A1501 Numeeriset menetelmät I (Numerical methods I) or equivalent passed.

Places for exchange-students? (Yes, number/No):

max 15

Places for Open University Students?(Yes, number/No):

max 5

BJ02A2041: Advanced Process Design, 5 cr

Validity: 01.08.2016 -
Form of study: Basic studies
Type: Course
Unit: LUT School of Engineering Science
Grading: Study modules 0-5,P/F
Teachers: Tuomas Koiranen, Esko Lahdenperä

Year:

M.Sc. (Tech.) 1

Period:

1

Teaching Language:

English

Teacher(s) in Charge:

Professor, D.Sc. (Tech.) Tuomas Koiranen, Lic. (Tech.) Esko Lahdenperä

Aims:

Upon completion of the module, the student has the following competencies:
– knows process life cycle and what kind of design activities are required during the life cycle
– understands how product design and process design are related
– knows what is conceptual design of processes: where it is aiming and what are the steps
– understands the role of modern simulation package during the process life cycle
– is able to apply a simulation package to support every step during conceptual process design.

Contents:

– Chemical process synthesis: objectives and steps
– Synthesis of separation sequences
– Chemical and physical properties and property estimation methods
– Chemical process material and energy balances, sizing and costing and economical evaluation
– Process performance analysis, process evaluation and optimization
– Energy integration in process design.

Teaching Methods:

Lectures and exercises 20 h. Self-study, assignments and group work 110 h.
Total workload 130 h.

Examination in Examination schedule (Yes/No):

No

Examination in Moodle (Yes/No):

No

Examination in Exam (Yes/No):

Yes

Assessment:

0–5, examination 20%, group work and reports 40%, individual assignments 40%.

Course Materials:

Basic study material delivered in Moodle.
Specific literature:
– Sinnot R.K., Chemical Engineering Design,(e-resource)
– Seider W.D., Seader J.D., Lewin D.R.Widago S. Product and Process Design Principles: Synthesis, Analysis and Evaluation
– Al-Malah Kamal I.M., Aspen Plus. Chemical Engineering Applications, (e-resource)
– Biegler L., Grossman I.E., Westerberg A.W.,Systematic methods of chemical process design.

Prerequisites:

BJ01A530 Prosessien simuloinnin perusteet (Basics of Process Simulation) or corresponding studies.
It is strongly recommended that students have taken basic studies in Chemical Engineering or have corresponding knowledge.

Places for exchange-students? (Yes, number/No):

max 5

Places for Open University Students?(Yes, number/No):

max 5

BJ02A2051: Process Intensification, 5 cr

Validity: 01.08.2016 -
Form of study: Basic studies
Type: Course
Unit: LUT School of Engineering Science
Grading: Study modules 0-5,P/F
Teachers: Arto Laari

Year:

M.Sc. (Tech.) 1

Period:

4

Teaching Language:

English

Teacher(s) in Charge:

Docent, D.Sc. (Tech.) Arto Laari

Aims:

Upon completion of the module, the student will be able to
- explain the goals of process intensification, describe advantages reached by it as well as typical methods of intensification
- explain and use the following applications of process intensification: intensified reactors

and separation equipment, combination of reaction and separation, hybrid separation, alternative energy sources, transforming a batch process to continuous one
- recognize possibilities to intensify and apply novel technology in existing processes.

Contents:

Teaching will include lectures, exercises and seminars. During the exercises, students will carry out a group work concerning intensification of some processes given by the lecturer.

Teaching Methods:

Lectures, seminars and exercises 28 h, 4th period. Group work, self-studies and preparation for seminars 102 h.
Total workload 130 h.

Examination in Examination schedule (Yes/No):

Yes

Examination in Moodle (Yes/No):

No

Examination in Exam (Yes/No):

No

Assessment:

0-5, written examination 50%, seminar report and exercises 50%.

Course Materials:

Lecture notes.

Places for exchange-students? (Yes, number/No):

15–

Places for Open University Students?(Yes, number/No):

max 5

BJ02A2061: Product Design, 5 cr

Validity: 01.08.2016 -
Form of study: Basic studies
Type: Course
Unit: LUT School of Engineering Science
Grading: Study modules 0-5,P/F
Teachers: Arto Laari

Year:

M.Sc. (Tech.) 2

Period:

1

Teaching Language:

English

Teacher(s) in Charge:

Docent, D.Sc. (Tech.) Arto Laari

Aims:

Upon completion of the module, the student will be able to: - nominate and classify chemical products - analyze customers's needs - create and develop ideas for chemical products - compare product ideas and make selections - apply his/hers chemical engineering knowledge
in product design - evaluate product costs and profitability.

Contents:

Teaching includes lectures and guided product design work. Students will carry out a product design project in design groups.

Teaching Methods:

Lectures, exercises and seminars 28 h. 1st period. Self-study and project work 102 h.
Total workload 130 h.

Examination in Examination schedule (Yes/No):

No

Examination in Moodle (Yes/No):

No

Examination in Exam (Yes/No):

No

Assessment:

0-5, project work 100%.

Course Materials:

Lecture slides.

Places for exchange-students? (Yes, number/No):

15–

Places for Open University Students?(Yes, number/No):

max 5

BJ02A2070: Project on Process and Plant Design, 10 cr

Validity: 01.08.2014 -
Form of study: Basic studies
Type: Course
Unit: LUT School of Engineering Science
Grading: Study modules 0-5,P/F
Teachers: Tuomas Koiranen

Year:

M.Sc. (Tech.) 2

Period:

1-2

Teaching Language:

English

Teacher(s) in Charge:

Professor, D.Sc. (Tech.) Tuomas Koiranen

Aims:

Upon completion of the module, the student will be able to - apply his/her chemical engineering knowledge to real industrial process design project - perform technical and economical design calculations - solve real design problem sstarting sometimes from limited and incomplete initial information - seek and create novel solutions to design problems.

Contents:

The projects are carried out in the groups of five students. The topics are from industry, for example, chemical production, waste treatment and prosessing, bioprocesses, metal processing, circular economy, energy industry. A typical topic is a feasibility study of a process covering a brief market survey, comparison of process alternatives, preliminary process design (process flow diagram, mass and energy balances, sizing of mainequipment, lay-out, cost and profitability estimation). Different aspects are emphasized in different projects, depending on the topic.

Teaching Methods:

Lectures 5 h, project meetings, 1st and 2nd period. Design and project work 250 h, 1st-2nd period. Total workload 260 h.

Examination in Examination schedule (Yes/No):

No

Examination in Moodle (Yes/No):

No

Examination in Exam (Yes/No):

No

Assessment:

0-5, design reports 100%.

Course Materials:

Lecture material, Moodle.
Additional literature e.g. Sinnott, R., Towler, C., Chemical engineering design, Elsevier, 2011
Peters, M.S.,Timmerhaus, K.D., West, R.E., Plant design and economics for chemical engineers, McGraw-Hill

Prerequisites:

BJ01A5020 Prosessi- ja tehdassuunnittelu or equivalent passed.
BJ02A2041 Advanced Process Design or equivalent passed.

Places for exchange-students? (Yes, number/No):

No

Places for Open University Students?(Yes, number/No):

max 5

BH50A1500: Bioenergy Technology Solutions, 6 cr

Validity: 01.08.2010 -
Form of study: Basic studies
Type: Course
Unit: LUT School of Energy Systems
Grading: Study modules 0-5,P/F
Teachers: Esa Vakkilainen

Year:

M.Sc. (Tech.) 2

Period:

2-3

Teaching Language:

English

Teacher(s) in Charge:

Professor, D.Sc. (Tech.) Esa Vakkilainen

Aims:

Upon completion of the course the student will be able to 1. discuss the EU bioenergy policies including the effects of carbontrading, RES and energy efficiency, 2. understand the role and limitations of bioenergy use in Europe, 3. create a strategic vision for any country to usebioenergy, 4. understand different bioenergy generation technologies, and 5. list the biofuel production technologies, and 6. Independently follow discussions around future directions of Bioenergy technology. Independent creation of large report.

Contents:

Comparison of various bioenergy visions. Technological solutions and case studies from biomass supply and biofuelrefining, end-use technologies of biofuels in different sectors. Bioenergy challenges. Bioenergy politics.

Teaching Methods:

12 h of lectures. Group assignment. Written examination. Independent study approximately: Written assignment 48 h. Preparation for the examination 16 h + the examination 3 h. Studying given materials 77 h.
Total workload 156 h.

Suitability for doctoral studies (Yes/Leave empty):

Yes

Examination in Examination schedule (Yes/No):

Yes

Examination in Moodle (Yes/No):

No

Examination in Exam (Yes/No):

No

Assessment:

0 - 5. Examination 60 %, assignment 40 %.

Course Materials:

Lecture notes.

Prerequisites:

BH61A0600 Bioenergy.

Places for exchange-students? (Yes, number/No):

No

Places for Open University Students?(Yes, number/No):

max 5

BJ02A0041: Master's Thesis and Seminar, 30 cr

Validity: 01.08.2017 -

Form of study: Basic studies

Type: Course

Unit: LUT School of Engineering Science

Grading: Study modules 0-5,P/F

Teachers: Ritva Tuunila

Note:

Teaching will start in period 1. Thesis work will mainly be done in periods 3-4.
All students planning to do their Master's thesis in the academic year 2018-2019 should enroll to the course in WebOodi before the beginning of the autumn semester.

Year:

M.Sc. (Tech.) 2

Period:

1-4

Teaching Language:

English

Teacher(s) in Charge:

Head of the degree programme, supervisor of thesis work

Aims:

Upon completion of the module, the student will be able to: - define a research problem or design task - select appropriate theories and methods for a restricted research problem or design task in the field - can find and use critically data, information and knowledge in the
field, and estimate their reliability - apply his/her chemical engineering knowledge to solve a restricted research problem or carry out a design task - apply his creativity to find new solutions or in best case to generate a new theory or new technology - report the results in
writing and orally and participate in a scientific discussion.

Contents:

The thesis is a research or design project. Students must demonstrate the ability to complete the project independently and following a plan. A report is prepared following the LUT instructions for the Master's thesis.

Teaching Methods:

Lectures 12 h. The thesis is connected to a seminar with other thesis students and their instructors. Seminar practices are announced separately each academic year.
Total workload 780 h.

Examination in Examination schedule (Yes/No):

No

Examination in Moodle (Yes/No):

No

Examination in Exam (Yes/No):

No

Assessment:

0-5, Master's thesis 100%.

Course Materials:

Moodle material

Prerequisites:

B.Sc. degree

Places for exchange-students? (Yes, number/No):

No

Places for Open University Students?(Yes, number/No):

No

KeDWTSpec: Specialisation in Water Treatment, 80 cr

Validity: 01.08.2018 -

Form of study:

Type: Study module

Unit: LUT School of Engineering Science

Grading: Study modules 0-5,P/F

No course descriptions.

Obligatory specialisation studies, 80 ECTS.

BJ02A1090: Environmental and Industrial Analytics, 5 cr

Validity: 01.01.2017 -
Form of study: Basic studies
Type: Course
Unit: LUT School of Engineering Science
Grading: Study modules 0-5,P/F
Teachers: Satu-Pia Reinikainen, Maaret Paakkunainen, Eeva Jernström

Note:

The course is suitable for distance learning.

Year:

M.Sc. (Tech.) 1

Period:

4

Teaching Language:

English

Teacher(s) in Charge:

Satu-Pia Reinikainen, D.Sc. (Tech.), Professor
Maaret Paakkunainen, D.Sc. (Tech.)
Eeva Jernström, D.Sc. (Tech.)

Aims:

By the end of the course, the student is expected to be able to
- understand role and state-of-art of analytics in environmental and industrial contexts
- understand the effect of digitalization as the 4th industrial revolution
- be able to apply process management skills in implementation of project work.

Contents:

Main themes addressed are reliable sampling, traceability of measurements, modern instrumentation, data handling, process and environmental control/monitoring, and license to operate. Students will carry out a project work on one of these topics, report and present it as the visual synthesis. In addition a study visit aiming at
improved understanding of analytics will be carried out with a problem based learning procedure. Course contains tutorial lectures on the topics, hands on workshops on sampling, statistical process monitoring, and study visits.

Teaching Methods:

8 h of Tutorials, 2 h Study visit, 20 h Online workshops, 30 h Project work, 70 h Independent work. Total workload 130 h.

Suitability for doctoral studies (Yes/Leave empty):

Yes

Examination in Examination schedule (Yes/No):

No

Examination in Moodle (Yes/No):

Yes

Examination in Exam (Yes/No):

Yes

Assessment:

Numerical assessment (0-5); 40 % Electronic or Moodle Exam, 30 % Project Work, 30 % Other Homework.

Course Materials:

To be announced.

Places for exchange-students? (Yes, number/No):

max 15

Places for Open University Students?(Yes, number/No):

max 5

BJ02A1031: Solution Chemistry, 5 cr

Validity: 01.01.2018 -
Form of study: Basic studies
Type: Course
Unit: LUT School of Engineering Science
Grading: Study modules 0-5,P/F

Note:

Starting from the academic year 2019-2020.

Year:

M.Sc. (Tech.) 2

Period:

1

Teaching Language:

English

Teacher(s) in Charge:

N.N.

Aims:

Upon completion of the module, the student has a deeper understanding on solution chemistry and the student is capable to evaluating the thermodynamic properties of electrolyte and nonelectrolyte solutions in the modern way.

Contents:

Ideal, ideally dilute, and real solutions. Experimental methods for measuring the activity and osmotic coefficients in solutions. The Debye-Hückel theory for electrolyte solutions. Pitzer equations for real electrolyte solutions. Concepts and equations needed in and associated with the thermodynamic formulation of the surface. Surfaces in electrolyte solutions and electrical double layer.

Teaching Methods:

Lectures 28 h, exercises 14 h, 1st period. Selfstudy 88 h. Total workload 130 h.

Suitability for doctoral studies (Yes/Leave empty):

Yes

Doctoral School course where enrollment is in WebOodi (Yes/Leave empty):

Yes

Examination in Examination schedule (Yes/No):

Yes

Examination in Moodle (Yes/No):

Yes

Examination in Exam (Yes/No):

No

Assessment:

Written examination 50%, Moodle assignments 50 %.

Course Materials:

Lecture notes and problems solution manuals based on the for example on the following textbooks:
Peter Atkins, Julio de Paula, and James Keeler. Atkins' Physical Chemistry, 11th Edition, 2017, Oxford University Press.
Kenneth Pitzer (edited), Activity Coefficients in Electrolyte Solutions, 2nd Edition, 2000, CRC Press, Boca Raton.

Prerequisites:

BJ01A3010 Kemiallinen termodynamiikka (Chemical Thermodynamics) or equivalent studies.

Places for exchange-students? (Yes, number/No):

max 10

Places for Open University Students?(Yes, number/No):

max 5

BJ02A3010: Membrane Technology, 5 cr

Validity: 01.08.2014 -

Form of study: Basic studies

Type: Course

Unit: LUT School of Engineering Science

Grading: Study modules 0-5,P/F

Teachers: Arto Pihlajamäki, Mika Mänttäri, Mari Kallioinen

Year:

M.Sc. (Tech.) 1

Period:

INT. 43 (lectures) + period 2 (laboratory work + seminars).

Teaching Language:

English

Teacher(s) in Charge:

Professor, D.Sc. Mika Mänttäri, Associate Professor, D.Sc. Mari Kallioinen, Associate Professor, D.Sc. Arto Pihlajamäki

Aims:

At the end of the course a student is expected to know how to: - explain the basic terms and membrane processes - interpret observed phenomena in the separation process and their influence to the separation process - compare the feasibility of membrane materials, modules
and manufacturing processes - choose the most appropriate membrane and membrane process for a separation process - identify the possibilities, benefits and limits of membrane processes.

Contents:

Membrane processes (micro-, ultra- and nanofiltration, reverse osmosis, pervaporation, etc.). Manufacturing membranes, membrane materials and structures, phenomena in membrane processes (fouling, concentration polarisation, etc.). Modules. Separation mechanisms.
Characterisation of membranes. Applications.

Teaching Methods:

Lectures, exercises and seminar presentations 21 h, self-study (Moodle) 50 h, seminar work and laboratory works and their reporting 30 h, preparation for exam and exam 29 h.
Total workload 130 h.

Examination in Examination schedule (Yes/No):

Yes

Examination in Moodle (Yes/No):

No

Examination in Exam (Yes/No):

No

Assessment:

0-5, written examination 70%, seminar and laboratory works 30%. Possible extra points from Moodle-assessments (0-10).

Course Materials:

Lecture presentations and additional material (Moodle): book chapters and articles.
Mulder, M., Basic Principles of Membrane Technology, 2nd ed., Kluwer, 1996/2003.

Places for exchange-students? (Yes, number/No):

max 15

Places for Open University Students?(Yes, number/No):

No

BJ02A3030: Solid-Liquid Separation, 5 cr

Validity: 01.08.2014 -

Form of study: Basic studies

Type: Course

Unit: LUT School of Engineering Science

Grading: Study modules 0-5,P/F

Teachers: Antti Häkkinen, Ritva Tuunila

Note:

Distance learning possible, except for laboratory work measurements, which are arranged for distance learning students in fixed contact teaching days at LUT.

Year:

M.Sc. (Tech.) 1

Period:

1-2

Teaching Language:

English

Teacher(s) in Charge:

Professor, D.Sc. (Tech.) Antti Häkkinen, Associate Professor, D.Sc. (Tech) Ritva Tuunila

Aims:

After completing the module the student can: - know the fundamental phenomena insolid-liquid separation - name different methods and equipment used for solid-liquid separation - select and size suitable equipment for separation processes based on suspension properties and data from laboratory tests - explain the effects of the characteristics of the solid material and the liquid on the separation and post treatment processes - define different filter media used in filtration and make a preliminary selection of a medium for different cases - perform an experimental test in laboratory scale - write a scientific report.

Contents:

The topics are as follows: Fundamentals of solid-liquid separation, filtration methods, operation of filters, cake formation and washing, deliquoring, design and modeling of filters and scale-up. Filter media and blinding. Experimental design in filtration test work.

Teaching Methods:

Lectures 18h, exercises 18 h, filtration laboratory work + report 20 h, literature review 20 h, Self-study 54 h.
Total workload 130 h.

Examination in Examination schedule (Yes/No):

Yes

Examination in Moodle (Yes/No):

No

Examination in Exam (Yes/No):

No

Assessment:

0-5, Written exam or assignments 60%, laboratory work 20%, literature review 20%.

Course Materials:

Additional material will be informed at lectures.

Prerequisites:

Knowledge of the fundamentals of particle characterization and mechanical separation methods.
Recommended literature: Fundamentals of Particle Technology by Richard Holdich, Chapters 1–8.

Places for exchange-students? (Yes, number/No):

Yes, max. 10

Places for Open University Students?(Yes, number/No):

Max 5

BJ03A1010: Introduction to Advanced Water Treatment, 5 cr

Validity: 01.08.2016 -
Form of study: Basic studies
Type: Course
Unit: LUT School of Engineering Science
Grading: Study modules 0-5,P/F
Teachers: Eveliina Repo, Mika Sillanpää

Note:

Suitable also for distance learning.

Year:

M.Sc. (Tech.) 1

Period:

1

Teaching Language:

English

Teacher(s) in Charge:

Assistant professor (tenure track) Chaker Necibi

Aims:

By the end of the course, the student is expected to be able to: - describe biological, chemical and physical treatment of water emissions - suggest a suitable treatment method based on the composition of the wastewater - solve simple mathematical problems related to water
treatment and water composition - solve case studies as a group work.

Contents:

Learning the principles of water treatment techniques such as biological methods, coagulation, flocculation, adsorption, advanced oxidation processes (AOPs), membrane technology, magnetic treatment, and electrochemical methods. Comparison of different water treatment techniques will be considered in the course from economic, environmental and technical sides. Case exercises will be conducted as a group work. Weekly homework exercises related to the topic of each week will be calculated in the class or individually.

Teaching Methods:

Lectures 14 h, exercises 8 h, case studies 16 h, 1st period. Preparation for the exam, case reports, independent workload 92 h.
Total workload 130 h.

Suitability for doctoral studies (Yes/Leave empty):

Yes

Examination in Examination schedule (Yes/No):

No

Examination in Moodle (Yes/No):

No

Examination in Exam (Yes/No):

Yes

Assessment:

0-5, exam 65%, case studies 25% and exercises 10%.

Course Materials:

Lecture notes. Moodle. Literature recommended by the teacher.

Places for exchange-students? (Yes, number/No):

max 15

Places for Open University Students?(Yes, number/No):

max 5

BJ03A1020: Biological Waste Water Treatment, 5 cr

Validity: 01.08.2016 -
Form of study: Basic studies
Type: Course
Unit: LUT School of Engineering Science
Grading: Study modules 0-5,P/F
Teachers: Mari Kallioinen

Year:

M.Sc. (Tech.) 2

Period:

1

Teaching Language:

English

Teacher(s) in Charge:

Associate professor, D.Sc. (Tech.) Mari Kallioinen

Aims:

After completing the course the student will have the basic knowledge of aerobic and anaerobic biological treatment processes. He/she will master the basic principles, terminology, reactor configurations, and related calculations of both processes. He/she understands the context of the biological waste water treatment processes to recycling of nutrients, bioenergy production and recovery and production of value-added compounds from waste waters and organic wastes. In addition, the student will after completing the course use the available literature in his/her research work, act as a part of a project work group and evaluate his/her own performance and communicate in a professional way in the project group.

Contents:

Biological wastewater treatment methods, professional terminology, built-up ecosystem, desired metabolism and reactor types, selection of microbes and enrichment, influence of temperature and other conditions on above-mentioned factors, basic knowledge on the biological methods used in removal of carbon, nitrogen and phosphorous, aerobic and anaerobic wastewater treatment, process alternatives and technologies, designing and operating modes of processes, controlling and optimization of processes, novel technologies, recovery of valuable products from waste originating (secondary raw materials) raw materials, aerobic and anaerobic technologies in the treatment of sewage sludges and organic wastes.

Teaching Methods:

Lectures and seminars 28 h, independent self-study (Moodle) 30 h, group works and literary works 52 h, preparation for exam and exam
20 h. Total workload 130 h.

Examination in Examination schedule (Yes/No):

Yes

Examination in Moodle (Yes/No):

No

Examination in Exam (Yes/No):

No

Assessment:

0-5 exam 70 %, Moodle exams and graded group and literary groups 30 %.

Course Materials:

Lecture material and additional material (Moodle), literature announced during the course.

Prerequisites:

BJ03A01010 Introduction to Advanced Water Treatment is recommended or corresponding knowledge.

Places for exchange-students? (Yes, number/No):

max 15

Places for Open University Students?(Yes, number/No):

max 5

BJ03A1040: Advanced Materials in Adsorption and Ion Exchange, 5 cr

Validity: 01.08.2016 -

Form of study: Basic studies

Type: Course

Unit: LUT School of Engineering Science

Grading: Study modules 0-5,P/F

Teachers: Mika Sillanpää, Chaker Necibi

Note:

Suitable also for distance learning.

Year:

M.Sc. (Tech.) 1

Period:

2

Teaching Language:

English

Teacher(s) in Charge:

Professor, D.Sc. (Tech.) Mika Sillanpää
Post-doctoral researcher, D.Sc. (Tech.) Chaker Necibi

Aims:

By the end of the course, the student is expected to be able to: - describe the conventional and novel adsorption and ion-exchange materials - describe the conventional and novel applications of adsorption and ion-exchange - select a suitable adsorption/ion-exchange material for a particular purpose - understand the surface reactions in sorption processes - use theoretical models to describe adsorption kinetics, isotherms and thermodynamics - solve problems through PBL group work.

Contents:

Learning the types and properties of conventional and novel adsorption and ion-exchange materials and their applications in water treatment. Learning to evaluate the economic and environmental aspects of the production and use of different sorption materials. Learning the
surface reactions and theories behind the sorption phenomena. Both individual and group work including PBL-method, exercises and modeling calculations will be conducted.

Teaching Methods:

Lectures and exercises 20 h, PBL group work 12 h, 2nd period. Preparation for the exam, PBL work, independent workload 98 h.
Total workload 130 h.

Suitability for doctoral studies (Yes/Leave empty):

Yes

Examination in Examination schedule (Yes/No):

No

Examination in Moodle (Yes/No):

No

Examination in Exam (Yes/No):

Yes

Assessment:

0-5, exam 50%, PBL group work 30% and homework 20%.

Course Materials:

Lecture notes. Moodle.

Prerequisites:

BJ03A1010 Introduction to Advanced Water Treatment

Places for exchange-students? (Yes, number/No):

max 10

Places for Open University Students?(Yes, number/No):

max 5

BJ03A2010: Advanced Oxidation Processes & Electrochemical Methods in Water Treatment, 5 cr

Validity: 01.08.2016 -

Form of study: Basic studies

Type: Course

Unit: LUT School of Engineering Science

Grading: Study modules 0-5,P/F

Teachers: Mika Sillanpää, Varsha Srivastava

Note:

Suitable also for distance learning.

Year:

M.Sc. (Tech.) 1

Period:

3

Teaching Language:

English

Teacher(s) in Charge:

Professor, D.Sc. (Tech.) Mika Sillanpää
Post-doctoral Researcher, D.Sc. (Tech.) Varsha Srivastava

Aims:

By the end of the course, the student is expected to be able to: - describe the conventional and novel methods of AOPs and electrochemical water treatment - describe the applications of AOPs and electrochemical water treatment - select a suitable method for the particular
purpose based on the composition of the water to be purified - understand the theory and chemical reactions involved in AOPs and electrochemical water treatment - solve case studies as a group work.

Contents:

Learning principles of AOPs and electrochemical water treatment. Learning how these methods can be utilized in different applications and which kind of waters can be purified. Economical, technical, and sustainability aspects of the methods will be considered. Real case examples and seminar work will be effectively utilized to give depth understanding of the methods.

Teaching Methods:

Lectures 10 h and seminars 20 h, case studies in small groups, individual seminar presentation and literature work Case reports, seminar and literature work, independent workload about 100 h.
Total workload 130 h.

Suitability for doctoral studies (Yes/Leave empty):

Yes

Examination in Examination schedule (Yes/No):

No

Examination in Moodle (Yes/No):

No

Examination in Exam (Yes/No):

No

Assessment:

0-5, case studies 40%, seminar presentation and literature work 60%.

Course Materials:

Lecture notes. Moodle. Literature recommended by the teacher.

Prerequisites:

BJ03A1010 Introduction to Advanced Water Treatment.

Places for exchange-students? (Yes, number/No):

max 10

Places for Open University Students?(Yes, number/No):

max 5

BJ03A2040: Research Project Course in Water Treatment, 10 cr

Validity: 01.08.2016 -
Form of study: Basic studies
Type: Course
Unit: LUT School of Engineering Science
Grading: Study modules 0-5,P/F
Teachers: Mika Sillanpää, Bhairavi Doshi

Year:

M.Sc. (Tech.) 1

Period:

3-4

Teaching Language:

English

Teacher(s) in Charge:

Professor, D.Sc. (Tech.) Mika Sillanpää
Junior Researcher, M.Sc. (Tech.) Bhairavi Doshi

Aims:

By the end of the course, the student is expected to be able to - carry out a research project step by step as a group work: planning, implementation, and reporting - utilize effectively the existent literature from the project field - work as a team member in a role assigned - write a scientific report from the work conducted - report the work conducted by oral presentation.

Contents:

Planning, implementation, and reporting a research project related to water treatment as a group work. Project includes a literature survey, planning experimental work, conducting experiments, analyzing the results, and reporting (written and oral). Short lectures and group
meetings related to the project work are included. Literature survey and planning part will start during 3rd period and experimental work will be carried out in Mikkeli.

Teaching Methods:

Research project as a group work. Lectures and seminars 20 h. Individual literature work to collect background information (40 h). Group meetings, laboratory work, and reporting according to given instructions 200 h. Total workload 260 h.

Examination in Examination schedule (Yes/No):

No

Examination in Moodle (Yes/No):

No

Examination in Exam (Yes/No):

No

Assessment:

0-5, individual literature work 30%, project work and reporting 70%.

Course Materials:

Lecture materials. Moodle. Literature from the field of the project's topic.

Prerequisites:

BJ03A1010 Introduction to Water Treatment

Places for exchange-students? (Yes, number/No):

max 5

Places for Open University Students?(Yes, number/No):

max 5

BJ02A0041: Master's Thesis and Seminar, 30 cr

Validity: 01.08.2017 -

Form of study: Basic studies

Type: Course

Unit: LUT School of Engineering Science

Grading: Study modules 0-5,P/F

Teachers: Ritva Tuunila

Note:

Teaching will start in period 1. Thesis work will mainly be done in periods 3-4.
All students planning to do their Master's thesis in the academic year 2018-2019 should enroll to the course in WebOodi before the beginning of the autumn semester.

Year:

M.Sc. (Tech.) 2

Period:

1-4

Teaching Language:

English

Teacher(s) in Charge:

Head of the degree programme, supervisor of thesis work

Aims:

Upon completion of the module, the student will be able to: - define a research problem or design task - select appropriate theories and methods for a restricted research problem or design task in the field - can find and use critically data, information and knowledge in the
field, and estimate their reliability - apply his/her chemical engineering knowledge to solve a restricted research problem or carry out a design task - apply his creativity to find new solutions or in best case to generate a new theory or new technology - report the results in
writing and orally and participate in a scientific discussion.

Contents:

The thesis is a research or design project. Students must demonstrate the ability to complete the project independently and following a plan. A report is prepared following the LUT instructions for the Master’s thesis.

Teaching Methods:

Lectures 12 h. The thesis is connected to a seminar with other thesis students and their instructors. Seminar practices are announced separately each academic year.
Total workload 780 h.

Examination in Examination schedule (Yes/No):

No

Examination in Moodle (Yes/No):

No

Examination in Exam (Yes/No):

No

Assessment:

0-5, Master’s thesis 100%.

Course Materials:

Moodle material

Prerequisites:

B.Sc. degree

Places for exchange-students? (Yes, number/No):

No

Places for Open University Students?(Yes, number/No):

No

BJ02A0050: Orientation to M.Sc. Studies, 1 cr

Validity: 01.01.2017 -

Form of study: Basic studies

Type: Course

Unit: LUT School of Engineering Science

Grading: Study modules 0-5,P/F

Teachers: Ritva Tuunila

Note:
Teaching is organized jointly for all Master’s Programmes in Chemical Engineering.
Year:
M.Sc. (Tech.) 1
Period:
1
Teaching Language:
English
Teacher(s) in Charge:
Associate Professor, D.Sc. (Tech) Ritva Tuunila
Aims:
After completing the course, the student - is familiar with the formal requirements of his/her studies and with the campus services and their appropriate use during his/her studies - is aware of information security issues - possesses good practices for safe laboratory working.
Contents:
During the course the student will learn about the relevant instructions affecting his/her studies and how to generate a personal study plan. The student will familiarize him/herself with the relevant staff of his/her degree programme and with the services provided by e.g. the Library and Study Services. The student will learn about the relevant laboratory safety instructions.
Teaching Methods:
Lectures 6 h, independent assignments 10 h, self-study 10 h. Total workload 26 h.
Examination in Examination schedule (Yes/No):
No
Examination in Moodle (Yes/No):
No
Examination in Exam (Yes/No):
No
Assessment:

Pass/fail. After completing the course assignments acceptably, the student passes the course.
Course Materials:
Moodle material
Places for exchange-students? (Yes, number/No):
No
Places for Open University Students?(Yes, number/No):
max 5

KeDDDSpec: Specialisation in Chemical and Process Engineering for double degree students, 69 - 81 cr

Validity: 01.08.2018 -

Form of study:

Type: Study module

Unit: LUT School of Engineering Science

Grading: Study modules 0-5,P/F

No course descriptions.

In addition to a Master's thesis, choose a min. of 39 ECTS of courses from the list below.

BJ02A2011: Modelling of Unit Operations, 5 cr

Validity: 01.01.2017 -

Form of study: Basic studies

Type: Course

Unit: LUT School of Engineering Science

Grading: Study modules 0-5,P/F

Teachers: Tuomo Kauranne, Dipal Shah

Year:

M.Sc. (Tech.) 1, M.Sc. (Tech.) 2

Period:

2

Teaching Language:

English

Teacher(s) in Charge:

Associate professor, Ph.D. Tuomo Kauranne

Aims:

After completing the module the student - can describe steady-state and transient unit operations with mathematical models - can validate models and estimate parameters from experimental data - can apply phenomenon based models in process development and design
tasks, such as sizing, optimization, and scale-up - can use mathematical and simulation software.

Contents:

Modeling and parameter estimation in Matlab, for Chemical Engineering and Applied Mathematics in general. The course presents kinetic models for processes that feature chemical reactions, temperature dependence, CSTR and batch reactors with and without cooling, plug flow and pipeline reactors.

Teaching Methods:

Lectures 24 h, exercises 14 h, 2nd period. Home assignments 70 h, self-study 22 h. Home assignments passed, no exam.
Total workload 130 h.

Suitability for doctoral studies (Yes/Leave empty):

Yes

Examination in Examination schedule (Yes/No):

No

Examination in Moodle (Yes/No):

No

Examination in Exam (Yes/No):

No

Assessment:

0-5. Half of the grade is decided by the share of exercises completed by the student, the other half by the quality of the work and reports produced from home assignments.

Course Materials:

In Moodle.

Prerequisites:

Either the Finnish course Johdatus tekniseen lasekntaan or Principles of Technical Computing, or corresponding skills in MATLAB programming.

Places for exchange-students? (Yes, number/No):

max 10

Places for Open University Students?(Yes, number/No):

max 10

BJ02A2000: Knowledge Discovery and Process Data Analysis, 5 cr

Validity: 01.08.2018 -

Form of study: Basic studies

Type: Course

Unit: LUT School of Engineering Science

Grading: Study modules 0-5,P/F

Note:

The course is suitable for distance learning.

Year:

M.Sc. (Tech.) 1

Period:

4

Teaching Language:

English

Teacher(s) in Charge:

Professor, D.Sc. (Tech.) Satu-Pia Reinikainen

Aims:

By the end of the course, the student is expected to
• Be aware of the effect of digitalization and automation on amount, nature, and quality of data from chemical engineering point of view
• have acquired a basic knowledge of the main concept of knowledge discovery process concerning industrial data
• be able to apply specified methods and methodology on data
• be able to apply management and cooperation skills in implementation of project work.

Contents:

The knowledge discovery is referring to the overall process of discovering useful knowledge from data. The knowledge discovery process is interactive and iterative and involves several steps starting from Learning the application domain and ending to Using the discovered Knowledge. Process data analysis can be part of the knowledge discovery process. Fundamental concepts - such as reliability of data, preprocessing (e.g., de-noising, deciding on strategies for handling missing data fields), data reduction, choosing methodology, validation, modelling, etc - will be addressed in tutorials, Moodle assignments, and discussions. The project work will be carried out in small groups that will define their own target, and working methodology. The course is suitable for distance learning.

Teaching Methods:

Online tutorials 7 h, online discussions and peer feedback 7 h, Moodle exams 7 h, and assignments 20 h. Project work 40 h, online independent study 49 h. Total workload 130 h.

Suitability for doctoral studies (Yes/Leave empty):

Yes

Examination in Examination schedule (Yes/No):

No

Examination in Moodle (Yes/No):

Yes

Examination in Exam (Yes/No):

No

Assessment:

Numerical assessment (0-5), Project work 40 %, assignments 30 %, Moodle exams and peer feedback 30 %.

Course Materials:

Tutorial videos, online material distributed or announced in Moodle.

Limitation for students? (Yes, number, priorities/Leave empty):

Yes, 50, Students in Chemical Engineering M.Sc. programme

Places for exchange-students? (Yes, number/No):

max 10

Places for Open University Students?(Yes, number/No):

max 10

BJ02A2030: Fluid Dynamics in Chemical Engineering, 5 cr

Validity: 01.08.2014 -
Form of study: Basic studies
Type: Course
Unit: LUT School of Engineering Science
Grading: Study modules 0-5,P/F
Teachers: Tuomas Koiranen

Year:

M.Sc. (Tech.) 1

Period:

3

Teaching Language:

English

Teacher(s) in Charge:

Professor, D.Sc. (Tech.) Tuomas Koiranen

Aims:

A student can: - Select, size and scale-up different mixing devices (stirred tanks, in-line mixers) for blending and multiphase mixing (solid-liquid mixing, liquid and gas dispersions) based on short-cut design methods. - Understand basics of fluid rheology and adapt the
information to mixing design. - Understand computational fluid dynamics (CFD) calculations and is able to solve basic fluid mixing problems with CFD programs.

Contents:

Design methods and scale-up of fluid mixers, rheology, mixing effects in chemical reactions. Theoretical basis of CFD and chemical engineering aspects.

Teaching Methods:

Exercise based lecturing 18 h, home exercises 32 h (in Moodle), fluid mixing demonstration 4 h and /or mixing case study (design work) 27 h, seminar 8 h, 3rd period. Self-study 41 h.
Total workload 130 h.

Examination in Examination schedule (Yes/No):

No

Examination in Moodle (Yes/No):

No

Examination in Exam (Yes/No):

No

Assessment:

0-5, 75% home exercises for passing course, 100% home exercises increases grade 20%.
Mixing case study report (failed/satisfactory/good). Good report increases grade 20%.
Examination 60% (exam grade at least 1 for passing course).

Course Materials:

Additional material will be informed at lectures. Material in Moodle.

Prerequisites:

BH40A1400 Virtaustekniikka I (Fluid Dynamics I) or equivalent passed, BM20A1501 Numeeriset menetelmät I (Numerical methods I) or equivalent passed.

Places for exchange-students? (Yes, number/No):

max 15

Places for Open University Students?(Yes, number/No):

max 5

BJ02A2041: Advanced Process Design, 5 cr

Validity: 01.08.2016 -

Form of study: Basic studies

Type: Course

Unit: LUT School of Engineering Science

Grading: Study modules 0-5,P/F

Teachers: Tuomas Koiranen, Esko Lahdenperä

Year:

M.Sc. (Tech.) 1

Period:

1

Teaching Language:

English

Teacher(s) in Charge:

Professor, D.Sc. (Tech.) Tuomas Koiranen, Lic. (Tech.) Esko Lahdenperä

Aims:

Upon completion of the module, the student has the following competencies:
– knows process life cycle and what kind of design activities are required during the life cycle
– understands how product design and process design are related
– knows what is conceptual design of processes: where it is aiming and what are the steps
– understands the role of modern simulation package during the process life cycle
– is able to apply a simulation package to support every step during conceptual process design.

Contents:

– Chemical process synthesis: objectives and steps
– Synthesis of separation sequences
– Chemical and physical properties and property estimation methods
– Chemical process material and energy balances, sizing and costing and economical evaluation
– Process performance analysis, process evaluation and optimization
– Energy integration in process design.

Teaching Methods:

Lectures and exercises 20 h. Self-study, assignments and group work 110 h.
Total workload 130 h.

Examination in Examination schedule (Yes/No):

No

Examination in Moodle (Yes/No):

No

Examination in Exam (Yes/No):

Yes

Assessment:

0–5, examination 20%, group work and reports 40%, individual assignments 40%.

Course Materials:

Basic study material delivered in Moodle.
Specific literature:
– Sinnot R.K., Chemical Engineering Design,(e-resource)
– Seider W.D., Seader J.D., Lewin D.R.Widago S. Product and Process Design Principles: Synthesis, Analysis and Evaluation
– Al-Malah Kamal I.M., Aspen Plus. Chemical Engineering Applications, (e-resource)
– Biegler L., Grossman I.E., Westerberg A.W.,Systematic methods of chemical process design.

Prerequisites:

BJ01A530 Prosessien simuloinnin perusteet (Basics of Process Simulation) or corresponding studies.
It is strongly recommended that students have taken basic studies in Chemical Engineering or have corresponding knowledge.

Places for exchange-students? (Yes, number/No):

max 5

Places for Open University Students?(Yes, number/No):

max 5

BJ02A2051: Process Intensification, 5 cr

Validity: 01.08.2016 -

Form of study: Basic studies

Type: Course

Unit: LUT School of Engineering Science

Grading: Study modules 0-5,P/F

Teachers: Arto Laari

Year:

M.Sc. (Tech.) 1

Period:

4

Teaching Language:

English

Teacher(s) in Charge:

Docent, D.Sc. (Tech.) Arto Laari

Aims:

Upon completion of the module, the student will be able to
- explain the goals of process intensification, describe advantages reached by it as well as typical methods of intensification
- explain and use the following applications of process intensification: intensified reactors and separation equipment, combination of reaction and separation, hybrid separation, alternative energy sources, transforming a batch process to continuous one
- recognize possibilities to intensify and apply novel technology in existing processes.

Contents:

Teaching will include lectures, exercises and seminars. During the exercises, students will carry out a group work concerning intensification of some processes given by the lecturer.

Teaching Methods:

Lectures, seminars and exercises 28 h, 4th period. Group work, self-studies and preparation for seminars 102 h.
Total workload 130 h.

Examination in Examination schedule (Yes/No):

Yes

Examination in Moodle (Yes/No):

No

Examination in Exam (Yes/No):

No

Assessment:

0-5, written examination 50%, seminar report and exercises 50%.

Course Materials:

Lecture notes.

Places for exchange-students? (Yes, number/No):

15–

Places for Open University Students?(Yes, number/No):

max 5

BJ02A2061: Product Design, 5 cr

Validity: 01.08.2016 -

Form of study: Basic studies

Type: Course

Unit: LUT School of Engineering Science

Grading: Study modules 0-5,P/F

Teachers: Arto Laari

Year:

M.Sc. (Tech.) 2

Period:

1

Teaching Language:

English

Teacher(s) in Charge:

Docent, D.Sc. (Tech.) Arto Laari

Aims:

Upon completion of the module, the student will be able to: - nominate and classify chemical products - analyze customers's needs - create and develop ideas for chemical products - compare product ideas and make selections - apply his/hers chemical engineering knowledge
in product design - evaluate product costs and profitability.

Contents:

Teaching includes lectures and guided product design work. Students will carry out a product design project in design groups.

Teaching Methods:

Lectures, exercises and seminars 28 h. 1st period. Self-study and project work 102 h.
Total workload 130 h.

Examination in Examination schedule (Yes/No):

No

Examination in Moodle (Yes/No):

No

Examination in Exam (Yes/No):

No

Assessment:

0-5, project work 100%.

Course Materials:

Lecture slides.

Places for exchange-students? (Yes, number/No):

15–

Places for Open University Students?(Yes, number/No):

max 5

BH50A1500: Bioenergy Technology Solutions, 6 cr

Validity: 01.08.2010 -

Form of study: Basic studies

Type: Course

Unit: LUT School of Energy Systems

Grading: Study modules 0-5,P/F

Teachers: Esa Vakkilainen

Year:

M.Sc. (Tech.) 2

Period:

2-3

Teaching Language:

English

Teacher(s) in Charge:

Professor, D.Sc. (Tech.) Esa Vakkilainen

Aims:

Upon completion of the course the student will be able to 1. discuss the EU bioenergy policies including the effects of carbontrading, RES and energy efficiency, 2. understand the role and limitations of bioenergy use in Europe, 3. create a strategic vision for any country to usebioenergy, 4. understand different bioenergy generation technologies, and 5. list the biofuel production technologies, and 6. Independently follow discussions around future directions of Bioenergy technology. Independent creation of large report.

Contents:

Comparison of various bioenergy visions. Technological solutions and case studies from biomass supply and biofuelrefining, end-use technologies of biofuels in different sectors. Bioenergy challenges. Bioenergy politics.

Teaching Methods:

12 h of lectures. Group assignment. Written examination. Independent study approximately: Written assignment 48 h. Preparation for the examination 16 h + the examination 3 h. Studying given materials 77 h.
Total workload 156 h.

Suitability for doctoral studies (Yes/Leave empty):

Yes

Examination in Examination schedule (Yes/No):

Yes

Examination in Moodle (Yes/No):

No

Examination in Exam (Yes/No):

No

Assessment:

0 - 5. Examination 60 %, assignment 40 %.

Course Materials:

Lecture notes.

Prerequisites:

BH61A0600 Bioenergy.

Places for exchange-students? (Yes, number/No):

No

Places for Open University Students?(Yes, number/No):

max 5

BJ02A1100: Biorefineries, 5 cr

Validity: 01.01.2018 -

Form of study: Basic studies

Type: Course

Unit: LUT School of Engineering Science

Grading: Study modules 0-5,P/F

Note:

The course is suitable for distance learning.
This course is mainly directed to the students in the digital Master's Programme in Biorefineries.

Year:

M.Sc. (Tech.) 1

Period:

3

Teaching Language:

English

Teacher(s) in Charge:

Associate professor, D.Sc. (Tech.) Eeva Jernström

Aims:

By the end of the course, the student is expected to be able to
- Understand the basic concept of a biorefinery and the various alternative concepts
- Understand the main biorefining processes, e.g. kraft pulp process, production of biofuels, further processing of different bio-based raw materials.
- Have general knowledge of current biorefinery products, their applicability to different end-uses
- Apply management and cooperation skills in implementation of project work in combined virtual and f2f working environment.

Contents:

The course covers the most typical biorefining-processes currently in use as well as some selected future processes. Topics include raw materials for biorefineries, processes and process conditions, most common biorefinery products and their end-uses. The course includes Moodle assignments and project work. The project work will be carried out individually or in small groups that will define their own target, and working methodology. The course is suitable for distance learning.

Teaching Methods:

Tutorials and workshops 5 h, 2nd period. Project work 50 h. Self Study of predefined material 75 h. Total workload 130 h.
The course includes Moodle assignments and project work. The project work will be carried out individually or in small groups that will define their own target, and working methodology

Examination in Examination schedule (Yes/No):

No

Examination in Moodle (Yes/No):

No

Examination in Exam (Yes/No):

No

Assessment:

0-5, Moodle assignments 60 %, Project work 40 %.

Course Materials:

Will be announced later.

Limitation for students? (Yes, number, priorities/Leave empty):

Yes, this course is mainly directed to the students in the digital Master's Programme in Biorefineries.

Places for exchange-students? (Yes, number/No):

No

Places for Open University Students?(Yes, number/No):

max 5

BJ02A2070: Project on Process and Plant Design, 10 cr

Validity: 01.08.2014 -
Form of study: Basic studies
Type: Course
Unit: LUT School of Engineering Science
Grading: Study modules 0-5,P/F
Teachers: Tuomas Koiranen

Year:

M.Sc. (Tech.) 2

Period:

1-2

Teaching Language:

English

Teacher(s) in Charge:

Professor, D.Sc. (Tech.) Tuomas Koiranen

Aims:

Upon completion of the module, the student will be able to - apply his/her chemical engineering knowledge to real industrial process design project - perform technical and economical design calculations - solve real design problem sstarting sometimes from limited and incomplete initial information - seek and create novel solutions to design problems.

Contents:

The projects are carried out in the groups of five students. The topics are from industry, for example, chemical production, waste treatment and prosessing, bioprocesses, metal processing, circular economy, energy industry. A typical topic is a feasibility study of a process covering a brief market survey, comparison of process alternatives, preliminary process design (process flow diagram, mass and energy balances, sizing of mainequipment, lay-out, cost and profitability estimation). Different aspects are emphasized in different projects, depending on the topic.

Teaching Methods:

Lectures 5 h, project meetings, 1st and 2nd period. Design and project work 250 h, 1st-2nd period. Total workload 260 h.

Examination in Examination schedule (Yes/No):

No

Examination in Moodle (Yes/No):

No

Examination in Exam (Yes/No):

No

Assessment:

0-5, design reports 100%.

Course Materials:

Lecture material, Moodle.
Additional literature e.g. Sinnott, R., Towler, C., Chemical engineering design, Elsevier, 2011
Peters, M.S.,Timmerhaus, K.D., West, R.E., Plant design and economics for chemical engineers, McGraw-Hill

Prerequisites:

BJ01A5020 Prosessi- ja tehdassuunnittelu or equivalent passed.
BJ02A2041 Advanced Process Design or equivalent passed.

Places for exchange-students? (Yes, number/No):

No

Places for Open University Students?(Yes, number/No):

max 5

BJ02A0041: Master's Thesis and Seminar, 30 cr

Validity: 01.08.2017 -

Form of study: Basic studies

Type: Course

Unit: LUT School of Engineering Science

Grading: Study modules 0-5,P/F

Teachers: Ritva Tuunila

Note:

Teaching will start in period 1. Thesis work will mainly be done in periods 3-4.
All students planning to do their Master's thesis in the academic year 2018-2019 should enroll to the course in WebOodi before the beginning of the autumn semester.

Year:

M.Sc. (Tech.) 2

Period:

1-4

Teaching Language:

English

Teacher(s) in Charge:

Head of the degree programme, supervisor of thesis work

Aims:

Upon completion of the module, the student will be able to: - define a research problem or design task - select appropriate theories and methods for a restricted research problem or design task in the field - can find and use critically data, information and knowledge in the
field, and estimate their reliability - apply his/her chemical engineering knowledge to solve a restricted research problem or carry out a design task - apply his creativity to find new solutions or in best case to generate a new theory or new technology - report the results in
writing and orally and participate in a scientific discussion.

Contents:

The thesis is a research or design project. Students must demonstrate the ability to complete the project independently and following a plan. A report is prepared following the LUT instructions for the Master’s thesis.

Teaching Methods:

Lectures 12 h. The thesis is connected to a seminar with other thesis students and their instructors. Seminar practices are announced separately each academic year.
Total workload 780 h.

Examination in Examination schedule (Yes/No):
No
Examination in Moodle (Yes/No):
No
Examination in Exam (Yes/No):
No
Assessment:
0-5, Master’s thesis 100%.
Course Materials:
Moodle material
Prerequisites:
B.Sc. degree
Places for exchange-students? (Yes, number/No):
No
Places for Open University Students?(Yes, number/No):
No

Descriptions of courses and study modules not included in the degree structures

KeSoD500: Advanced Chemistry, 20 - 25 cr

Validity: 01.08.2018 -
Form of study:
Type: Study module
Unit: LUT School of Engineering Science
Grading: Study modules 0-5,P/F

Aims:
After the completion of the minor in Advanced Chemistry the student
• has acquired a basic knowledge of the fundamental concepts of chemistry relevant to the major
• can apply his/her knowledge to select and to evaluate analytical or instrumental methodology in chemical analysis
• demonstrates sufficient knowledge to be applied in analytical work.

Choose a min. of 20 ECTS

BJ02A1012: Concepts of Analytical and Inorganic Chemistry, 5 cr

Validity: 01.01.2018 -
Form of study: Basic studies
Type: Course
Unit: LUT School of Engineering Science
Grading: Study modules 0-5,P/F

Note:
The course is suitable for distance learning.

Year:

M.Sc. (Tech.) 1

Period:

4

Teaching Language:

English

Teacher(s) in Charge:

Satu-Pia Reinikainen, D.Sc. (Tech.), Professor
Tiina Virtanen, M.Sc., Junior Researcher

Aims:

By the end of the course, the student is expected to
- have acquired a basic knowledge of the fundamental concepts of inorganic chemistry relevant to the major
- be able to apply analytical methodology or the principles of selected instrumental methods in chemical analysis.

Contents:

This course contains two independent modules.1) Inorganic chemistry module is designed to prepare students for further study in inorganic chemistry or, more generally, employment in physical ormaterials science fields. The content include advanced concepts in structure, bonding, and chemical/physical properties of inorganic compounds, understanding of which is central to the study of all areas of chemistry. 2) Analytical chemistry module covers design, operational principles and application of modern instrumental methods used in chemical analysis via case studies. There are literature recommended for each module, and online interactive assignments. Students will work in small groups on the topic selected. The course is suitable for distance learning.

Teaching Methods:

Module 1: Assignments 20 h, discussions 10 h, peer feedback 10 h, Moodle quiz 5 h, online independent study 20 h, Module 2: Assignments 40 h, peer feedback and Moodle quiz 5 h, online independent study 20 h. Total workload 130 h.

Examination in Examination schedule (Yes/No):

No

Examination in Moodle (Yes/No):

No

Examination in Exam (Yes/No):

No

Assessment:

Numerical assessment (0-5), Module 1/2 50 %/50 % of total (assignments 60 %, online quizzes, peer feedback 40 %).

Course Materials:

Module 1: List of text books available in Moodle, Module 2: online material via Moodle.

Places for exchange-students? (Yes, number/No):

max 10

Places for Open University Students?(Yes, number/No):

max 10

BJ02A1600: Biobased Materials and Advanced Organic Chemistry, 5 cr

Validity: 01.01.2018 -

Form of study: Basic studies

Type: Course

Unit: LUT School of Engineering Science

Grading: Study modules 0-5,P/F

Year:

M.Sc. (Tech.) 1

Period:

4

Teaching Language:

English

Teacher(s) in Charge:

Arto Pihlajamäki, D.Sc. (Tech.), Researcher/Teacher
Tiina Virtanen, M.Sc. (Tech.), Junior Researcher

Aims:

By the end of the course, a student is expected to:
- gain the basic chemical and technological understanding of the production of most important bioproducts from renewable resources
- be able to apply fundamental concepts of organic chemistry into application of biopolymers and their reactions.

Contents:

This course contains two modules. Biobased Materials module will introduce novel biomaterials and focus on properties of biobased polymers, their processing, reactions and applications. Advanced Organic Chemistry module gives extended knowledge in the structure and reactivity of organic biomolecules. There are lists of literature recommended for each module. Students will work in small groups on selected topics.

Teaching Methods:

Moodle lessons: Module 1 60 h, Module 2 60 h, 4th period. Quizzes and activities in Moodle 10 h. Total workload 130 h.

Examination in Examination schedule (Yes/No):

No

Examination in Moodle (Yes/No):

Yes

Examination in Exam (Yes/No):

No

Assessment:

0-5, Moodle exam, assignments and fulfilled activities in Moodle, project work reports in Modules 1 and 2.

Course Materials:

To be announced.

Prerequisites:

BJ01A1040 Orgaanisen kemian perusteet (Basic Organic Chemistry) or equivalent knowledge.

Limitation for students? (Yes, number, priorities/Leave empty):

Yes, 50, Students in Chemical Engineering M.Sc. programme.

Places for exchange-students? (Yes, number/No):

max 5

Places for Open University Students?(Yes, number/No):

max 5

BJ02A1031: Solution Chemistry, 5 cr

Validity: 01.01.2018 -
Form of study: Basic studies
Type: Course
Unit: LUT School of Engineering Science
Grading: Study modules 0-5,P/F

Note:

Starting from the academic year 2019-2020.

Year:

M.Sc. (Tech.) 2

Period:

1

Teaching Language:

English

Teacher(s) in Charge:

N.N.

Aims:

Upon completion of the module, the student has a deeper understanding on solution chemistry and the student is capable to evaluating the thermodynamic properties of electrolyte and nonelectrolyte solutions in the modern way.

Contents:

Ideal, ideally dilute, and real solutions. Experimental methods for measuring the activity and osmotic coefficients in solutions. The Debye-Hückel theory for electrolyte solutions. Pitzer equations for real electrolyte solutions. Concepts and equations needed in and associated with the thermodynamic formulation of the surface. Surfaces in electrolyte solutions and electrical double layer.

Teaching Methods:

Lectures 28 h, exercises 14 h, 1st period. Selfstudy 88 h. Total workload 130 h.

Suitability for doctoral studies (Yes/Leave empty):

Yes

Doctoral School course where enrollment is in WebOodi (Yes/Leave empty):

Yes

Examination in Examination schedule (Yes/No):

Yes

Examination in Moodle (Yes/No):

Yes

Examination in Exam (Yes/No):

No

Assessment:

Written examination 50%, Moodle assignments 50 %.

Course Materials:

Lecture notes and problems solution manuals based on the for example on the following textbooks:
Peter Atkins, Julio de Paula, and James Keeler. Atkins' Physical Chemistry, 11th Edition, 2017, Oxford University Press.
Kenneth Pitzer (edited), Activity Coefficients in Electrolyte Solutions, 2nd Edition, 2000, CRC Press, Boca Raton.

Prerequisites:

BJ01A3010 Kemiallinen termodynamiikka (Chemical Thermodynamics) or equivalent studies.

Places for exchange-students? (Yes, number/No):

max 10

Places for Open University Students?(Yes, number/No):

max 5

BJ02A4070: Principles of Thermal Gas-Liquid Processes, 5 cr

Validity: 01.01.2018 -

Form of study: Basic studies

Type: Course

Unit: LUT School of Engineering Science

Grading: Study modules 0-5,P/F

Year:

M.Sc. (Tech.) 1

Period:

2

Teaching Language:

English

Teacher(s) in Charge:

Professor, D.Sc. (Tech.) Tuomas Koiranen

Aims:

Student understands distillation, evaporation and gas scrubbing technologies, including equipment structures and sizing principles. Student can design gas-liquid contactors by hand, is able to form mathematical calculation models, and can apply equations for computer simulation.

Contents:

Gas-liquid contactor theory, sizing principles and equations, calculation examples, computer exercises. Distillation, evaporation, gas scrubbing.

Teaching Methods:

Combined lectures and exercises 10 h, homeworks 72 h, self learning 48 h.
Total workload 130 h.

Examination in Examination schedule (Yes/No):

No

Examination in Moodle (Yes/No):

Yes

Examination in Exam (Yes/No):

No

Assessment:

Examination grading scale 0-5. minimum 75 % of homeworks correct, returning to moodle.

Course Materials:

Course books:
Niket S. Kaisare, Computational Techniques for Process Simulation and Analysis Using MATLAB®, Taylor&Francis, 2017
Hussein K. Abdel-Aal, Chemical Engineering Primer with Computer Applications, Taylor&Francis, 2016
Felder, R.M., Elementary Principles of Chemical Processes, Wiley, 2004

Prerequisites:

BM20A1501 Numerical Methods or equivalent, BM20A4301 Introduction to Technical Computation or equivalent

Places for exchange-students? (Yes, number/No):

max 10

Places for Open University Students?(Yes, number/No):

max 5

BJ03A1040: Advanced Materials in Adsorption and Ion Exchange, 5 cr

Validity: 01.08.2016 -
Form of study: Basic studies
Type: Course
Unit: LUT School of Engineering Science
Grading: Study modules 0-5,P/F
Teachers: Mika Sillanpää, Chaker Necibi

Note:

Suitable also for distance learning.

Year:

M.Sc. (Tech.) 1

Period:

2

Teaching Language:

English

Teacher(s) in Charge:

Professor, D.Sc. (Tech.) Mika Sillanpää
Post-doctoral researcher, D.Sc. (Tech.) Chaker Necibi

Aims:

By the end of the course, the student is expected to be able to: - describe the conventional and novel adsorption and ion-exchange materials - describe the conventional and novel applications of adsorption and ion-exchange - select a suitable adsorption/ion-exchange material for a particular purpose - understand the surface reactions in sorption processes - use theoretical models to describe adsorption kinetics, isotherms and thermodynamics - solve problems through PBL group work.

Contents:

Learning the types and properties of conventional and novel adsorption and ion-exchange materials and their applications in water treatment. Learning to evaluate the economic and environmental aspects of the production and use of different sorption materials. Learning the
surface reactions and theories behind the sorption phenomena. Both individual and group work including PBL-method, exercises and modeling calculations will be conducted.

Teaching Methods:

Lectures and exercises 20 h, PBL group work 12 h, 2nd period. Preparation for the exam, PBL work, independent workload 98 h.
Total workload 130 h.

Suitability for doctoral studies (Yes/Leave empty):

Yes

Examination in Examination schedule (Yes/No):

No

Examination in Moodle (Yes/No):

No

Examination in Exam (Yes/No):

Yes

Assessment:

0-5, exam 50%, PBL group work 30% and homework 20%.

Course Materials:

Lecture notes. Moodle.

Prerequisites:

BJ03A1010 Introduction to Advanced Water Treatment

Places for exchange-students? (Yes, number/No):

max 10

Places for Open University Students?(Yes, number/No):

max 5

KeSoD300: Advanced Process Engineering, 20 - 35 cr

Validity: 01.08.2018 -

Form of study:

Type: Study module

Unit: LUT School of Engineering Science

Grading: Study modules 0-5,P/F

Aims:

After the completion of the minor in Advanced Process Engineering the student
• has advanced knowledge in relevant unit processes used in process industry
• is aware of effect and importance of digitalization and process automation, and knowledge discovery concerning industrial data of chemical processes
• is able to seek out and understand scientific information to be applied in chemical process engineering.

Choose a min. of 20 ECTS.

BJ02A3010: Membrane Technology, 5 cr

Validity: 01.08.2014 -

Form of study: Basic studies

Type: Course

Unit: LUT School of Engineering Science

Grading: Study modules 0-5,P/F

Teachers: Arto Pihlajamäki, Mika Mänttäri, Mari Kallioinen

Year:

M.Sc. (Tech.) 1

Period:

INT. 43 (lectures) + period 2 (laboratory work + seminars).

Teaching Language:

English

Teacher(s) in Charge:

Professor, D.Sc. Mika Mänttäri, Associate Professor, D.Sc. Mari Kallioinen, Associate Professor, D.Sc. Arto Pihlajamäki

Aims:

At the end of the course a student is expected to know how to: - explain the basic terms and membrane processes - interpret observed phenomena in the separation process and their influence to the separation process - compare the feasibility of membrane materials, modules
and manufacturing processes - choose the most appropriate membrane and membrane process for a separation process - identify the possibilities, benefits and limits of membrane processes.

Contents:

Membrane processes (micro-, ultra- and nanofiltration, reverse osmosis, pervaporation, etc.). Manufacturing membranes, membrane materials and structures, phenomena in membrane processes (fouling, concentration polarisation, etc.). Modules. Separation mechanisms.
Characterisation of membranes. Applications.

Teaching Methods:

Lectures, exercises and seminar presentations 21 h, self-study (Moodle) 50 h, seminar work and laboratory works and their reporting 30 h, preparation for exam and exam 29 h.
Total workload 130 h.

Examination in Examination schedule (Yes/No):

Yes

Examination in Moodle (Yes/No):

No

Examination in Exam (Yes/No):

No

Assessment:

0-5, written examination 70%, seminar and laboratory works 30%. Possible extra points from Moodle-assessments (0-10).

Course Materials:

Lecture presentations and additional material (Moodle): book chapters and articles.
Mulder, M., Basic Principles of Membrane Technology, 2nd ed., Kluwer, 1996/2003.

Places for exchange-students? (Yes, number/No):

max 15

Places for Open University Students?(Yes, number/No):

No

BJ02A3021: Chemical Separation Methods, 5 cr

Validity: 01.01.2017 -
Form of study: Basic studies
Type: Course
Unit: LUT School of Engineering Science
Grading: Study modules 0-5,P/F
Teachers: Tuomo Sainio

Year:

M.Sc. (Tech.) 1

Period:

3

Teaching Language:

English

Teacher(s) in Charge:

Professor, D.Sc. (Tech.) Tuomo Sainio

Aims:

After the module the student
- can describe the principles of main chemical separation methods
- can describe process concepts and industrial uses of the chemical separation methods
- understands the dynamic behavior of periodically operated separation processes
- can select methods and materials for separation and purification of complex mixtures
- can design and optimize such separation processes.

Contents:

Overview of the fundamentals of adsorption and ion exchange. Dynamics of adsorption and ion exchange columns and the use of equilibrium theory in process design. Industrial liquid-solid and gas-solid adsorption processes. Industrial scale chromatography and application examples. Single column and multicolumn chromatography process concepts, design methods, and process performance. Short introduction to liquid-liquid chromatography and supercritical fluid extraction.

Teaching Methods:

Lectures, simulations, exercises, and seminars 30 h. Preparation of presentations, home assignments, and independent study 100 h.
Total workload 130 h.

Examination in Examination schedule (Yes/No):

No

Examination in Moodle (Yes/No):

No

Examination in Exam (Yes/No):

No

Assessment:

0 - 5. Project work, reports, assignments, and presentations 100%.

Course Materials:

Lecture material and necessary simulation tools are distributed during the course.

Prerequisites:

Basics of process design and engineering mathematics. The course involves two time-intensive project works as well as other assignments.

Limitation for students? (Yes, number, priorities/Leave empty):

Yes, 35, students in the MSc programmes of Chemical Engineering.

Places for exchange-students? (Yes, number/No):

max 5

Places for Open University Students?(Yes, number/No):

max 5

BJ02A3030: Solid-Liquid Separation, 5 cr

Validity: 01.08.2014 -

Form of study: Basic studies

Type: Course

Unit: LUT School of Engineering Science

Grading: Study modules 0-5,P/F

Teachers: Antti Häkkinen, Ritva Tuunila

Note:

Distance learning possible, except for laboratory work measurements, which are arranged for distance learning students in fixed contact teaching days at LUT.

Year:

M.Sc. (Tech.) 1

Period:

1-2

Teaching Language:

English

Teacher(s) in Charge:

Professor, D.Sc. (Tech.) Antti Häkkinen, Associate Professor, D.Sc. (Tech) Ritva Tuunila

Aims:

After completing the module the student can: - know the fundamental phenomena insolid-liquid separation - name different methods and equipment used for solid-liquid separation - select and size suitable equipment for separation processes based on suspension properties and data from laboratory tests - explain the effects of the characteristics of the solid material and the liquid on the separation and post treatment processes - define different filter media used in filtration and make a preliminary selection of a medium for different cases - perform an experimental test in laboratory scale - write a scientific report.

Contents:

The topics are as follows: Fundamentals of solid-liquid separation, filtration methods, operation of filters, cake formation and washing, deliquoring, design and modeling of filters and scale-up. Filter media and blinding. Experimental design in filtration test work.

Teaching Methods:

Lectures 18h, exercises 18 h, filtration laboratory work + report 20 h, literature review 20 h, Self-study 54 h.
Total workload 130 h.

Examination in Examination schedule (Yes/No):

Yes

Examination in Moodle (Yes/No):

No

Examination in Exam (Yes/No):

No

Assessment:

0-5, Written exam or assignments 60%, laboratory work 20%, literature review 20%.

Course Materials:

Additional material will be informed at lectures.

Prerequisites:

Knowledge of the fundamentals of particle characterization and mechanical separation methods. Recommended literature: Fundamentals of Particle Technology by Richard Holdich, Chapters 1–8.

Places for exchange-students? (Yes, number/No):

Yes, max. 10

Places for Open University Students?(Yes, number/No):

Max 5

BJ02A2000: Knowledge Discovery and Process Data Analysis, 5 cr

Validity: 01.08.2018 -

Form of study: Basic studies

Type: Course

Unit: LUT School of Engineering Science

Grading: Study modules 0-5,P/F

Note:

The course is suitable for distance learning.

Year:

M.Sc. (Tech.) 1

Period:

4

Teaching Language:

English

Teacher(s) in Charge:

Professor, D.Sc. (Tech.) Satu-Pia Reinikainen

Aims:

By the end of the course, the student is expected to
• Be aware of the effect of digitalization and automation on amount, nature, and quality of data from chemical engineering point of view
• have acquired a basic knowledge of the main concept of knowledge discovery process concerning industrial data
• be able to apply specified methods and methodology on data
• be able to apply management and cooperation skills in implementation of project work.

Contents:

The knowledge discovery is referring to the overall process of discovering useful knowledge from data. The knowledge discovery process is interactive and iterative and involves several steps starting from Learning the application domain and ending to Using the discovered Knowledge. Process data analysis can be part of the knowledge discovery process. Fundamental concepts - such as reliability of data, preprocessing (e.g., de-noising, deciding on strategies for handling missing data fields), data reduction, choosing methodology, validation, modelling, etc - will be addressed in tutorials, Moodle assignments, and discussions. The project work will be carried out in small groups that will define their own target, and working methodology. The course is suitable for distance learning.

Teaching Methods:

Online tutorials 7 h, online discussions and peer feedback 7 h, Moodle exams 7 h, and assignments 20 h. Project work 40 h, online independent study 49 h. Total workload 130 h.

Suitability for doctoral studies (Yes/Leave empty):

Yes

Examination in Examination schedule (Yes/No):

No

Examination in Moodle (Yes/No):

Yes

Examination in Exam (Yes/No):

No

Assessment:

Numerical assessment (0-5), Project work 40 %, assignments 30 %, Moodle exams and peer feedback 30 %.

Course Materials:

Tutorial videos, online material distributed or announced in Moodle.

Limitation for students? (Yes, number, priorities/Leave empty):

Yes, 50, Students in Chemical Engineering M.Sc. programme

Places for exchange-students? (Yes, number/No):

max 10

Places for Open University Students?(Yes, number/No):

max 10

BJ02A2061: Product Design, 5 cr

Validity: 01.08.2016 -
Form of study: Basic studies
Type: Course
Unit: LUT School of Engineering Science
Grading: Study modules 0-5,P/F
Teachers: Arto Laari

Year:

M.Sc. (Tech.) 2

Period:

1

Teaching Language:

English

Teacher(s) in Charge:

Docent, D.Sc. (Tech.) Arto Laari

Aims:

Upon completion of the module, the student will be able to: - nominate and classify chemical products - analyze customers's needs - create and develop ideas for chemical products - compare product ideas and make selections - apply his/hers chemical engineering knowledge
in product design - evaluate product costs and profitability.

Contents:

Teaching includes lectures and guided product design work. Students will carry out a product design project in design groups.

Teaching Methods:

Lectures, exercises and seminars 28 h. 1st period. Self-study and project work 102 h.
Total workload 130 h.

Examination in Examination schedule (Yes/No):

No

Examination in Moodle (Yes/No):

No

Examination in Exam (Yes/No):

No

Assessment:

0-5, project work 100%.

Course Materials:

Lecture slides.

Places for exchange-students? (Yes, number/No):

15–

Places for Open University Students?(Yes, number/No):

max 5

BJ02A3051: Hydrometallurgy, 5 cr

Validity: 01.08.2016 -
Form of study: Basic studies
Type: Course
Unit: LUT School of Engineering Science
Grading: Study modules 0-5,P/F
Teachers: Sami Virolainen

Year:

M.Sc. (Tech.) 1

Period:

3

Teaching Language:

English

Teacher(s) in Charge:

Post-doctoral Researcher, D.Sc. (Tech.) Sami Virolainen

Aims:

After the course, the students:
- understand the fundamentals of hydrometallurgy.
- are familiar with methods and equipment used in hydrometallurgical processes.
- have perspective on industrial utilization of hydrometallurgy.

Contents:

Background. Solution chemistry of hydrometallurgical solutions. Leaching. Treatment of leach solutions by solvent extraction, ion exchange and adsorption. Metal recovery by precipitation and by electrochemical methods.

Teaching Methods:

Lectures 24 h. Exercises (including labs) 35 h. Self-study 71 h.
Total workload 130 h.

Examination in Examination schedule (Yes/No):

No

Examination in Moodle (Yes/No):

Yes

Examination in Exam (Yes/No):

Yes

Assessment:

0-5, written Electronic Exam 90%, digital calculation exam in Moodle 10%. Exercises passed.

Course Materials:

Lectures and lecture slides.
Supporting material: Fathi Habashi, Textbook of Hydrometallurgy, Metallurgie Extractive Quebec, 2nd edition, 1999.

Places for exchange-students? (Yes, number/No):

15–

Places for Open University Students?(Yes, number/No):

max 10

BJ02A4070: Principles of Thermal Gas-Liquid Processes, 5 cr

Validity: 01.01.2018 -

Form of study: Basic studies

Type: Course

Unit: LUT School of Engineering Science

Grading: Study modules 0-5,P/F

Year:

M.Sc. (Tech.) 1

Period:

2

Teaching Language:

English

Teacher(s) in Charge:

Professor, D.Sc. (Tech.) Tuomas Koiranen

Aims:

Student understands distillation, evaporation and gas scrubbing technologies, including equipment structures and sizing principles. Student can design gas-liquid contactors by hand, is able to form mathematical calculation models, and can apply equations for computer simulation.

Contents:

Gas-liquid contactor theory, sizing principles and equations, calculation examples, computer exercises. Distillation, evaporation, gas scrubbing.

Teaching Methods:

Combined lectures and exercises 10 h, homeworks 72 h, self learning 48 h.
Total workload 130 h.

Examination in Examination schedule (Yes/No):

No

Examination in Moodle (Yes/No):

Yes

Examination in Exam (Yes/No):

No

Assessment:

Examination grading scale 0-5. minimum 75 % of homeworks correct, returning to moodle.

Course Materials:

Course books:
Niket S. Kaisare, Computational Techniques for Process Simulation and Analysis Using MATLAB®, Taylor&Francis, 2017
Hussein K. Abdel-Aal, Chemical Engineering Primer with Computer Applications, Taylor&Francis, 2016
Felder, R.M., Elementary Principles of Chemical Processes, Wiley, 2004

Prerequisites:

BM20A1501 Numerical Methods or equivalent, BM20A4301 Introduction to Technical Computation or equivalent

Places for exchange-students? (Yes, number/No):

max 10

Places for Open University Students?(Yes, number/No):

max 5

KeSoD200: Advanced Water Treatment, 20 - 25 cr

Validity: 01.01.2016 -
Form of study:
Type: Study module
Unit: LUT School of Engineering Science
Grading: Study modules 0-5,P/F

Aims:
After the completion of the minor in Advanced Water Treatment the student
• has comprehensive understanding of the BAT and future water treatment technologies, covering advanced oxidation and various separation methods
• has adopted the principles of sustainability in water treatment
• demonstrates understanding of relevant theories and techniques in water treatment
• has the required problem-solving skills, and the ability to independently use knowledge, equipment and tools for the design and development of practical water treatment applications.

Choose a min. of 20 ECTS

BJ03A1010: Introduction to Advanced Water Treatment, 5 cr

Validity: 01.08.2016 -
Form of study: Basic studies
Type: Course
Unit: LUT School of Engineering Science
Grading: Study modules 0-5,P/F
Teachers: Eveliina Repo, Mika Sillanpää

Note:

Suitable also for distance learning.

Year:

M.Sc. (Tech.) 1

Period:

1

Teaching Language:

English

Teacher(s) in Charge:

Assistant professor (tenure track) Chaker Necibi

Aims:

By the end of the course, the student is expected to be able to: - describe biological, chemical and physical treatment of water emissions - suggest a suitable treatment method based on the composition of the wastewater - solve simple mathematical problems related to water treatment and water composition - solve case studies as a group work.

Contents:

Learning the principles of water treatment techniques such as biological methods, coagulation, flocculation, adsorption, advanced oxidation processes (AOPs), membrane technology, magnetic treatment, and electrochemical methods. Comparison of different water treatment techniques will be

considered in the course from economic, environmental and technical sides. Case exercises will be conducted as a group work. Weekly homework exercises related to the topic of each week will be calculated in the class or individually.

Teaching Methods:

Lectures 14 h, exercises 8 h, case studies 16 h, 1st period. Preparation for the exam, case reports, independent workload 92 h.
Total workload 130 h.

Suitability for doctoral studies (Yes/Leave empty):

Yes

Examination in Examination schedule (Yes/No):

No

Examination in Moodle (Yes/No):

No

Examination in Exam (Yes/No):

Yes

Assessment:

0-5, exam 65%, case studies 25% and exercises 10%.

Course Materials:

Lecture notes. Moodle. Literature recommended by the teacher.

Places for exchange-students? (Yes, number/No):

max 15

Places for Open University Students?(Yes, number/No):

max 5

BJ03A1020: Biological Waste Water Treatment, 5 cr

Validity: 01.08.2016 -
Form of study: Basic studies
Type: Course
Unit: LUT School of Engineering Science
Grading: Study modules 0-5,P/F
Teachers: Mari Kallioinen

Year:

M.Sc. (Tech.) 2

Period:

1

Teaching Language:

English

Teacher(s) in Charge:

Associate professor, D.Sc. (Tech.) Mari Kallioinen

Aims:

After completing the course the student will have the basic knowledge of aerobic and anaerobic biological treatment processes. He/she will master the basic principles, terminology, reactor configurations, and related calculations of both processes. He/she understands the context of the biological waste water treatment processes to recycling of nutrients, bioenergy production and recovery and production of value-added compounds from waste waters and organic wastes. In addition, the student will after completing the course use the available literature in his/her research work, act as a part

of a project work group and evaluate his/her own performance and communicate in a professional way in the project group.

Contents:

Biological wastewater treatment methods, professional terminology, built-up ecosystem, desired metabolism and reactor types, selection of microbes and enrichment, influence of temperature and other conditions on above-mentioned factors, basic knowledge on the biological methods used in removal of carbon, nitrogen and phosphorous, aerobic and anaerobic wastewater treatment, process alternatives and technologies, designing and operating modes of processes, controlling and optimization of processes, novel technologies, recovery of valuable products from waste originating (secondary raw materials) raw materials, aerobic and anaerobic technologies in the treatment of sewage sludges and organic wastes.

Teaching Methods:

Lectures and seminars 28 h, independent self-study (Moodle) 30 h, group works and literary works 52 h, preparation for exam and exam
20 h. Total workload 130 h.

Examination in Examination schedule (Yes/No):

Yes

Examination in Moodle (Yes/No):

No

Examination in Exam (Yes/No):

No

Assessment:

0-5 exam 70 %, Moodle exams and graded group and literary groups 30 %.

Course Materials:

Lecture material and additional material (Moodle), literature announced during the course.

Prerequisites:

BJ03A01010 Introduction to Advanced Water Treatment is recommended or corresponding knowledge.

Places for exchange-students? (Yes, number/No):

max 15

Places for Open University Students?(Yes, number/No):

max 5

BJ03A1040: Advanced Materials in Adsorption and Ion Exchange, 5 cr

Validity: 01.08.2016 -
Form of study: Basic studies
Type: Course
Unit: LUT School of Engineering Science
Grading: Study modules 0-5,P/F
Teachers: Mika Sillanpää, Chaker Necibi

Note:

Suitable also for distance learning.

Year:

M.Sc. (Tech.) 1

Period:

2

Teaching Language:

English

Teacher(s) in Charge:

Professor, D.Sc. (Tech.) Mika Sillanpää
Post-doctoral researcher, D.Sc. (Tech.) Chaker Necibi

Aims:

By the end of the course, the student is expected to be able to: - describe the conventional and novel adsorption and ion-exchange materials - describe the conventional and novel applications of adsorption and ion-exchange - select a suitable adsorption/ion-exchange material for a particular purpose - understand the surface reactions in sorption processes - use theoretical models to describe adsorption kinetics, isotherms and thermodynamics - solve problems through PBL group work.

Contents:

Learning the types and properties of conventional and novel adsorption and ion-exchange materials and their applications in water treatment. Learning to evaluate the economic and environmental aspects of the production and use of different sorption materials. Learning the
surface reactions and theories behind the sorption phenomena. Both individual and group work including PBL-method, exercises and modeling calculations will be conducted.

Teaching Methods:

Lectures and exercises 20 h, PBL group work 12 h, 2nd period. Preparation for the exam, PBL work, independent workload 98 h.
Total workload 130 h.

Suitability for doctoral studies (Yes/Leave empty):

Yes

Examination in Examination schedule (Yes/No):

No

Examination in Moodle (Yes/No):

No

Examination in Exam (Yes/No):

Yes

Assessment:

0-5, exam 50%, PBL group work 30% and homework 20%.

Course Materials:

Lecture notes. Moodle.

Prerequisites:

BJ03A1010 Introduction to Advanced Water Treatment

Places for exchange-students? (Yes, number/No):

max 10

Places for Open University Students?(Yes, number/No):

max 5

BJ03A2010: Advanced Oxidation Processes & Electrochemical Methods in Water Treatment, 5 cr

Validity: 01.08.2016 -
Form of study: Basic studies
Type: Course
Unit: LUT School of Engineering Science
Grading: Study modules 0-5,P/F
Teachers: Mika Sillanpää, Varsha Srivastava

Note:

Suitable also for distance learning.

Year:

M.Sc. (Tech.) 1

Period:

3

Teaching Language:

English

Teacher(s) in Charge:

Professor, D.Sc. (Tech.) Mika Sillanpää
Post-doctoral Researcher, D.Sc. (Tech.) Varsha Srivastava

Aims:

By the end of the course, the student is expected to be able to: - describe the conventional and novel methods of AOPs and electrochemical water treatment - describe the applications of AOPs and electrochemical water treatment - select a suitable method for the particular
purpose based on the composition of the water to be purified - understand the theory and chemical reactions involved in AOPs and electrochemical water treatment - solve case studies as a group work.

Contents:

Learning principles of AOPs and electrochemical water treatment. Learning how these methods can be utilized in different applications and which kind of waters can be purified. Economical, technical, and sustainability aspects of the methods will be considered. Real case examples and seminar work will be effectively utilized to give depth understanding of the methods.

Teaching Methods:

Lectures 10 h and seminars 20 h, case studies in small groups, individual seminar presentation and literature work Case reports, seminar and literature work, independent workload about 100 h.
Total workload 130 h.

Suitability for doctoral studies (Yes/Leave empty):

Yes

Examination in Examination schedule (Yes/No):

No

Examination in Moodle (Yes/No):

No

Examination in Exam (Yes/No):

No

Assessment:

0-5, case studies 40%, seminar presentation and literature work 60%.

Course Materials:

Lecture notes. Moodle. Literature recommended by the teacher.

Prerequisites:

BJ03A1010 Introduction to Advanced Water Treatment.

Places for exchange-students? (Yes, number/No):

max 10

Places for Open University Students?(Yes, number/No):

max 5

BJ02A3010: Membrane Technology, 5 cr

Validity: 01.08.2014 -

Form of study: Basic studies

Type: Course

Unit: LUT School of Engineering Science

Grading: Study modules 0-5,P/F

Teachers: Arto Pihlajamäki, Mika Mänttäri, Mari Kallioinen

Year:

M.Sc. (Tech.) 1

Period:

INT. 43 (lectures) + period 2 (laboratory work + seminars).

Teaching Language:

English

Teacher(s) in Charge:

Professor, D.Sc. Mika Mänttäri, Associate Professor, D.Sc. Mari Kallioinen, Associate Professor, D.Sc. Arto Pihlajamäki

Aims:

At the end of the course a student is expected to know how to: - explain the basic terms and membrane processes - interpret observed phenomena in the separation process and their influence to the separation process - compare the feasibility of membrane materials, modules
and manufacturing processes - choose the most appropriate membrane and membrane process for a separation process - identify the possibilities, benefits and limits of membrane processes.

Contents:

Membrane processes (micro-, ultra- and nanofiltration, reverse osmosis, pervaporation, etc.). Manufacturing membranes, membrane materials and structures, phenomena in membrane processes (fouling, concentration polarisation, etc.). Modules. Separation mechanisms.
Characterisation of membranes. Applications.

Teaching Methods:

Lectures, exercises and seminar presentations 21 h, self-study (Moodle) 50 h, seminar work and laboratory works and their reporting 30 h, preparation for exam and exam 29 h.
Total workload 130 h.

Examination in Examination schedule (Yes/No):

Yes

Examination in Moodle (Yes/No):

No

Examination in Exam (Yes/No):

No

Assessment:

0-5, written examination 70%, seminar and laboratory works 30%. Possible extra points from Moodle-assessments (0-10).

Course Materials:

Lecture presentations and additional material (Moodle): book chapters and articles.
Mulder, M., Basic Principles of Membrane Technology, 2nd ed., Kluwer, 1996/2003.

Places for exchange-students? (Yes, number/No):

max 15

Places for Open University Students?(Yes, number/No):

No

KeSoD400: Biobased Chemical Engineering, 20 - 30 cr

Validity: 01.08.2018 -
Form of study:
Type: Study module
Unit: LUT School of Engineering Science
Grading: Study modules 0-5,P/F

Aims:
After the completion of the minor in Biobased Chemical Engineering the student
• has knowledge of the modern bio-based industry, its processes and available raw materials
• has advanced knowledge of relevant unit processes used in bio-based industry
• has knowledge of sustainable solutions and technologies integrated to bio-refineries
• is able to seek out and understand scientific information to be applied in bio-based chemical engineering.

Choose a min. of 20 ECTS. This minor is suitable for distance learning.

BJ02A1090: Environmental and Industrial Analytics, 5 cr

Validity: 01.01.2017 -
Form of study: Basic studies
Type: Course
Unit: LUT School of Engineering Science
Grading: Study modules 0-5,P/F
Teachers: Satu-Pia Reinikainen, Maaret Paakkunainen, Eeva Jernström

Note:

The course is suitable for distance learning.

Year:

M.Sc. (Tech.) 1

Period:

4

Teaching Language:

English

Teacher(s) in Charge:

Satu-Pia Reinikainen, D.Sc. (Tech.), Professor
Maaret Paakkunainen, D.Sc. (Tech.)
Eeva Jernström, D.Sc. (Tech.)

Aims:

By the end of the course, the student is expected to be able to
- understand role and state-of-art of analytics in environmental and industrial contexts
- understand the effect of digitalization as the 4th industrial revolution
- be able to apply process management skills in implementation of project work.

Contents:

Main themes addressed are reliable sampling, traceability of measurements, modern instrumentation, data handling, process and environmental control/monitoring, and license to operate. Students will carry out a project work on one of these topics, report and present it as the visual synthesis. In addition a study visit aiming at
improved understanding of analytics will be carried out with a problem based learning procedure. Course contains tutorial lectures on the topics, hands on workshops on sampling, statistical process monitoring, and study visits.

Teaching Methods:

8 h of Tutorials, 2 h Study visit, 20 h Online workshops, 30 h Project work, 70 h Independent work. Total workload 130 h.

Suitability for doctoral studies (Yes/Leave empty):

Yes

Examination in Examination schedule (Yes/No):

No

Examination in Moodle (Yes/No):

Yes

Examination in Exam (Yes/No):

Yes

Assessment:

Numerical assessment (0-5); 40 % Electronic or Moodle Exam, 30 % Project Work, 30 % Other Homework.

Course Materials:

To be announced.

Places for exchange-students? (Yes, number/No):

max 15

Places for Open University Students?(Yes, number/No):

max 5

BJ02A1100: Biorefineries, 5 cr

Validity: 01.01.2018 -

Form of study: Basic studies

Type: Course

Unit: LUT School of Engineering Science

Grading: Study modules 0-5,P/F

Note:

The course is suitable for distance learning.
This course is mainly directed to the students in the digital Master's Programme in Biorefineries.

Year:

M.Sc. (Tech.) 1

Period:

3

Teaching Language:

English

Teacher(s) in Charge:

Associate professor, D.Sc. (Tech.) Eeva Jernström

Aims:

By the end of the course, the student is expected to be able to
- Understand the basic concept of a biorefinery and the various alternative concepts
- Understand the main biorefining processes, e.g. kraft pulp process, production of biofuels, further processing of different bio-based raw materials.
- Have general knowledge of current biorefinery products, their applicability to different end-uses
- Apply management and cooperation skills in implementation of project work in combined virtual and f2f working environment.

Contents:

The course covers the most typical biorefining-processes currently in use as well as some selected future processes. Topics include raw materials for biorefineries, processes and process conditions, most common biorefinery products and their end-uses. The course includes Moodle assignments and project work. The project work will be carried out individually or in small groups that will define their own target, and working methodology. The course is suitable for distance learning.

Teaching Methods:

Tutorials and workshops 5 h, 2nd period. Project work 50 h. Self Study of predefined material 75 h. Total workload 130 h.
The course includes Moodle assignments and project work. The project work will be carried out individually or in small groups that will define their own target, and working methodology

Examination in Examination schedule (Yes/No):

No

Examination in Moodle (Yes/No):

No

Examination in Exam (Yes/No):

No

Assessment:

0-5, Moodle assignments 60 %, Project work 40 %.

Course Materials:

Will be announced later.

Limitation for students? (Yes, number, priorities/Leave empty):

Yes, this course is mainly directed to the students in the digital Master's Programme in Biorefineries.

Places for exchange-students? (Yes, number/No):

No

Places for Open University Students?(Yes, number/No):

max 5

BJ02A1200: Bioeconomy, 5 cr

Validity: 01.01.2018 -
Form of study: Basic studies
Type: Course
Unit: LUT School of Engineering Science
Grading: Study modules 0-5,P/F

Note:

This course is suitable for distance learning.

Year:

M.Sc. (Tech.) 1

Period:

3-4

Teaching Language:

English

Teacher(s) in Charge:

Associate professor, D.Sc. (Tech.), Eeva Jernström
Professor, D.Sc. (Tech.) Mika Sillanpää

Aims:

By the end of the course, the student is expected to
- gain the basic understanding of various perspectives of bioeconomy
- gain updated knowledge of modern biorefineries and the basic prerequisites for operation and sustainable business.

Contents:

The study entities are: The multidimensional impact of bioeconomy on Europe, The implementation of bioeconomy, the sustainability – all three dimensions - aspects of bioeconomy. The course is carried as assignments based on selected topics from the book and additional material. Course is planned for distance learning.

Teaching Methods:

Individual studying and assigments based on the book. Moodle is used as the learning platform.

Examination in Examination schedule (Yes/No):

No

Examination in Moodle (Yes/No):

No

Examination in Exam (Yes/No):

No

Assessment:

0-5, Moodle assigments 100 %.

Course Materials:

Book: A Sustainable Bioeconomy The green industrial revolution by Professors Mika Sillanpää and Chaker Ncibi.
Other related material announced later.

Places for exchange-students? (Yes, number/No):

No

Places for Open University Students?(Yes, number/No):

max 5

BJ02A1500: Current Issues in Enabling Technologies for Circular Economy, 5 cr

Validity: 01.01.2018 -
Form of study: Basic studies
Type: Course
Unit: LUT School of Engineering Science
Grading: Study modules 0-5,P/F

Note:

The course is suitable for distance learning.

Year:

M.Sc. (Tech.) 1

Period:

4

Teaching Language:

English

Teacher(s) in Charge:

Jutta Nuortila-Jokinen, Docent, D.Sc., Associate professor

Aims:

The aim of this new course is to familiarise students widely into circular economy with the focus on the current and novel technologies that enable the transformation from linear to circular economy.

Contents:

The detailed content will be announced later. The course will be executed in co-operation with Oulu University.

Teaching Methods:

The course is 100 % digitalized.

Examination in Examination schedule (Yes/No):

No

Examination in Moodle (Yes/No):

Yes

Examination in Exam (Yes/No):

No

Assessment:

0-5. Moodle exam and/or assignment. Details to be announced later.

Course Materials:

To be announced later.

Places for exchange-students? (Yes, number/No):

15–

Places for Open University Students?(Yes, number/No):

15–

BJ02A1600: Biobased Materials and Advanced Organic Chemistry, 5 cr

Validity: 01.01.2018 -
Form of study: Basic studies
Type: Course
Unit: LUT School of Engineering Science
Grading: Study modules 0-5,P/F

Year:

M.Sc. (Tech.) 1

Period:

4

Teaching Language:

English

Teacher(s) in Charge:

Arto Pihlajamäki, D.Sc. (Tech.), Researcher/Teacher
Tiina Virtanen, M.Sc. (Tech.), Junior Researcher

Aims:

By the end of the course, a student is expected to:
- gain the basic chemical and technological understanding of the production of most important bioproducts from renewable resources
- be able to apply fundamental concepts of organic chemistry into application of biopolymers and their reactions.

Contents:

This course contains two modules. Biobased Materials module will introduce novel biomaterials and focus on properties of biobased polymers, their processing, reactions and applications. Advanced Organic Chemistry module gives extended knowledge in the structure and reactivity of organic biomolecules. There are lists of literature recommended for each module. Students will work in small groups on selected topics.

Teaching Methods:

Moodle lessons: Module 1 60 h, Module 2 60 h, 4th period. Quizzes and activities in Moodle 10 h. Total workload 130 h.

Examination in Examination schedule (Yes/No):

No

Examination in Moodle (Yes/No):

Yes

Examination in Exam (Yes/No):

No

Assessment:

0-5, Moodle exam, assignments and fulfilled activities in Moodle, project work reports in Modules 1 and 2.

Course Materials:

To be announced.

Prerequisites:

BJ01A1040 Orgaanisen kemian perusteet (Basic Organic Chemistry) or equivalent knowledge.

Limitation for students? (Yes, number, priorities/Leave empty):

Yes, 50, Students in Chemical Engineering M.Sc. programme.

Places for exchange-students? (Yes, number/No):

max 5

Places for Open University Students?(Yes, number/No):

max 5

BJ02A4070: Principles of Thermal Gas-Liquid Processes, 5 cr

Validity: 01.01.2018 -
Form of study: Basic studies
Type: Course
Unit: LUT School of Engineering Science
Grading: Study modules 0-5,P/F

Year:

M.Sc. (Tech.) 1

Period:

2

Teaching Language:

English

Teacher(s) in Charge:

Professor, D.Sc. (Tech.) Tuomas Koiranen

Aims:

Student understands distillation, evaporation and gas scrubbing technologies, including equipment structures and sizing principles. Student can design gas-liquid contactors by hand, is able to form mathematical calculation models, and can apply equations for computer simulation.

Contents:

Gas-liquid contactor theory, sizing principles and equations, calculation examples, computer exercises. Distillation, evaporation, gas scrubbing.

Teaching Methods:

Combined lectures and exercises 10 h, homeworks 72 h, self learning 48 h.
Total workload 130 h.

Examination in Examination schedule (Yes/No):

No

Examination in Moodle (Yes/No):

Yes

Examination in Exam (Yes/No):

No

Assessment:

Examination grading scale 0-5. minimum 75 % of homeworks correct, returning to moodle.

Course Materials:

Course books:
Niket S. Kaisare, Computational Techniques for Process Simulation and Analysis Using MATLAB®, Taylor&Francis, 2017
Hussein K. Abdel-Aal, Chemical Engineering Primer with Computer Applications, Taylor&Francis, 2016
Felder, R.M., Elementary Principles of Chemical Processes, Wiley, 2004

Prerequisites:

BM20A1501 Numerical Methods or equivalent, BM20A4301 Introduction to Technical Computation or equivalent

Places for exchange-students? (Yes, number/No):

max 10

Places for Open University Students?(Yes, number/No):

max 5