Catalogue report

LUT School of Engineering Science

Master's Programme in Chemical Engineering for Water Treatment

Master’s Programme in Chemical Engineering for Water Treatment 2017-2018 (120 ECTS cr)

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 the completion of the MSc programme in Chemical Engineering for Water Treatment the student:

- has comprehensive understanding of the BAT and future water treatment technologies, covering advanced oxidation and various separation methods
- is able to demonstrate the required knowledge in process and environmental analytics and monitoring
- has adopted the principles of sustainability in water treatment
- demonstrates critical 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.
- is able to work with others in task-oriented 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 Master's degree (120 ECTS) consists of core studies, specialisation studies, minor studies and 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 our partner universities. The Double Degree Programme has a separate degree structure of its own.

See Uni-portal:
Chemical Engineering for Water Treatment

Degree structures

Degree Structure

The Master's degree (120 ECTS) consists of core studies, specialisation studies, minor studies and elective studies. The Master's Thesis and Seminar is included in the specialisation studies, and the Thesis must be written in English in the programmes taught in English.

The students of Chemical Engineering for Water Treatment have recommendations on how to choose the minor: KeSaD210 Separation Technology, KeSaD920 Green Process Technology or KeSoD100 Process Design.

Electives can be any courses offered by LUT if the required prerequisites are fulfilled. Studies in other universities /from abroad or a max. of 10 ECTS of internship (BJ02A0030 Work Internship in Master's Degree, 2-10 ECTS) may be included upon application, too.

This MSc is also available as a Double Degree Programme for the students of our partner universities. The Double Degree Programme has a separate degree structure of its own (contact study counselling for details).

See the degree structure for details.

Master's Programme in Chemical Engineering for Water Treatment 2017-2018 (Edited 19.6.2017)

Degree structure status: published

Academic year: 2017-18

Beginning date of the academic year: 01.08.2017

Core Studies (min 20 cp)

Students admitted directly to this MSc programme have to take Orientation to M.Sc. Studies, 1 ECTS, too, in addition to the other core studies. Accordingly, the amount of core studies is 21 ECTS. Students continuing from the B.Sc. of LUT to this M.Sc. programme take 20 ECTS of core studies.

KeDWTCore: Master's Programme in Chemical Engineering for Water Treatment Core Studies, 20 - 21 cp
- *Choose Orientation to M.Sc. Studies, if you have been admitted directly to this M.Sc. programme.*
  - BJ02A0050: Orientation to M.Sc. Studies, 1 cp
- *Obligatory to all students.*
  - BJ03A1010: Introduction to Advanced Water Treatment, 5 cp
  - BJ02A3010: Membrane Technology, 5 cp
  - BJ02A3030: Solid-Liquid Separation, 5 cp
  - BJ03A1020: Biological Waste Water Treatment, 5 cp

Specialisation Studies (min 60 cp)

BJ03A1040: Advanced Materials in Adsorption and Ion Exchange, 5 cp
BJ03A2010: Advanced Oxidation Processes & Electrochemical Methods in Water Treatment, 5 cp
BJ02A1090: Environmental and Industrial Analytics, 5 cp
BJ02A0041: Master's Thesis and Seminar, 30 cp
BJ03A2040: Research Project Course in Water Treatment, 10 cp

BJ03A2030: Water Treatment in Mining, 5 cp

Minor (min 20 cp)

Choose one of the following minors:
KeSaD210 Separation Technology
KeSaD920 Green Process Technology or
KeSoD100 Process Design.

Electives

Choose enough elective 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 universites /from studies abroad or a max. of 10 ECTS of internship (BJ02A0030 Work Internship in Master's Degree, 2-10 ECTS) may be included upon application, too.

Courses and study modules not included in degree structures

The students of Chemical Engineering for Water Treatment have **recommendations on how to choose the minor** :

KeSaD210 Separation Technology
KeSaD920 Green Process Technology or
KeSoD100 Process Design.

When choosing **Separation Technology** as your minor, please note that there are two courses that overlap with your specialisation studies. For the minor it is recommended to choose BJ02A4041 Processing of Biomaterials 5 ECTS credits to replace these two courses.

When choosing **Green Process Technology** as your minor, please note that there are two courses that overlap with your specialisation studies. For the minor it is recommended to choose BJ02A3010 Membrane Technology 5 ECTS credits to replace these two courses.

KeSaD920: Green Process Technology, 20 - 26 cp
- *Choose a min. of 20 ECTS*
  - BJ02A4041: Processing of Biomaterials, 5 cp
  - BJ02A4051: Development of New Sustainable Products and Solutions, 5 cp
  - BH50A1500: Bioenergy Technology Solutions, 6 cp
  - BJ03A1020: Biological Waste Water Treatment, 5 cp
  - BJ02A1090: Environmental and Industrial Analytics, 5 cp

KeSoD100: Process Design, 20 - 32 cp
- *Choose a min. of 20 ECTS*
  - BJ02A2041: Advanced Process Design, 5 cp
  - BJ02A2020: Process Control, 5 cp
  - BJ02A2051: Process Intensification, 5 cp
  - BJ02A2061: Product Design, 5 cp
  - BJ02A2011: Modelling of Unit Operations, 5 cp

KeSaD210: Separation Technology, 20 - 26 cp
- *Choose a min. of 20 ECTS*

BJ02A3010: Membrane Technology, 5 cp
BJ02A3030: Solid-Liquid Separation, 5 cp
BJ02A3040: Crystallization, 5 cp
BJ02A3051: Hydrometallurgy, 5 cp
BJ02A3021: Chemical Separation Methods, 5 cp

Course descriptions

Descriptions of courses and study modules included in the degree structures

KeDWTCore: Master's Programme in Chemical Engineering for Water Treatment Core Studies, 20 - 21 cp

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

No course descriptions.

Choose Orientation to M.Sc. Studies, if you have been admitted directly to this M.Sc. programme.

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

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: Riina Salmimies

Note:
Teaching is organized jointly for all Master’s Programmes in Chemical Engineering.
Year:
M.Sc.1
Period:
1
Teaching Language:
Teaching language or languages of course, e.g. Finnish or Finnish and English.
Teacher(s) in Charge:
Head of the degree programme.
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.

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.

Teaching Methods:

Lectures 6 h, independent study 20 h. Total workload 26 h.

Examination in Examination schedule (Yes/No):

No

Examination in Moodle (Yes/No):

No

Examination in Exam (Yes/No):

No

Number of mid-term examinations:

0

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):

No

Obligatory to all students.

BJ03A1010: Introduction to Advanced Water Treatment, 5 cp

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, Eveliina Repo

Note:

Replaces the course BJ02A4010 Industrial Water Treatment.

Year:

M.Sc. 1

Period:

1

Teaching Language:

English

Teacher(s) in Charge:

Professor, D.Sc. (Tech.) Mika Sillanpää, Researcher, D.Sc. (Tech.) Eveliina Repo

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 - describe environmental regulations and trends - 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 about 92 h. Total workload about 130 h.

Suitability for doctoral studies (Yes/Leave empty):

Yes

Examination in Exam (Yes/No):

Yes

Assessment:

0-5, exam 50%, case studies 40% and exercises 10%.

Course Materials:

Lecture notes. Moodle.

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

Yes, 15 places for exchange students.

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

This course has 1-5 places for open university students. More information on the web site for open university instructions.

BJ02A3010: Membrane Technology, 5 cp

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: Mika Mänttäri, Arto Pihlajamäki, Mari Kallioinen

Year:

M.Sc. (Tech.) 1

Period:

2 + intensive week (lectures)

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 extrapoints 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):

Yes, 15 places for exchange students.

BJ02A3030: Solid-Liquid Separation, 5 cp

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

Year:

M.Sc. (Tech.) 1

Period:

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 in solid-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 18 h, exercises 18 h, filtration laboratory work 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 examination 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, then number of places is not limited if prerequisites are OK.

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

This course has 1-5 places for open university students. More information on the web site for open university instructions.

BJ03A1020: Biological Waste Water Treatment, 5 cp

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

Note:

Starting from 2017-2018

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, energy efficiency of processes, 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, self-study (Moodle) 30 h, group works and literary works 52 h, preparation for exam and exam 20 h, total work load 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.

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

Yes, 15 places for exchange students.

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

This course has 1-5 places for open university students.

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

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

Year:
M.Sc. (Tech.) 1
Period:
2
Teaching Language:
English
Teacher(s) in Charge:
Researcher, D.Sc. (Tech.) Eveliina Repo
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, 2ndd period. Preparation for the exam, PBL work, independent workload about 98 h. Total workload about 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
Number of mid-term examinations:
0
Assessment:
0-5, exam 40%, PBL group work 40% and homework 20%.
Course Materials:
Lecture notes. Moodle.
Prerequisites:
BJ03A1010 Introduction to Advanced Water Treatment
Places for exchange-students? (Yes, number/No):
No
Places for Open University Students?(Yes, number/No):
This course has 1-5 places for open university students. More information on the web site for open university instructions.

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

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

Year:
M.Sc. (Tech.) 1
Period:
3
Teaching Language:
English
Teacher(s) in Charge:
Professor, D.Sc. (Tech.) Mika Sillanpää, Researcher, D.Sc. (Tech.) Eveliina Repo
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 10 h, case studies in small groups, individual seminar presentation and literature work Case reports, seminar and literature work, independent workload about 110 h. Total workload about 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
Number of mid-term examinations:
0
Assessment:
0-5, case studies 40%, seminar presentation and literature work 60%.
Course Materials:
Lecture notes. Moodle.
Prerequisites:
BJ03A1010 Introduction to Advanced Water Treatment
Places for exchange-students? (Yes, number/No):
No
Places for Open University Students?(Yes, number/No):
This course has 1-5 places for open university students. More information on the web site for open university instructions.

BJ02A1090: Environmental and Industrial Analytics, 5 cp

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, Eeva Jernström, Maaret Paakkunainen

Note:

Replaces courses: BJ03A1050 Environmental and Process Analytics & Monitoring and BJ02A1060 Prosessi- ja ympäristöanalytiikka.

Year:
M.Sc. (Tech.) 1

Period:
4

Teaching Language:
English

Teacher(s) in Charge:
Satu-Pia Reinikainen, D.Sc., Docent, Associate Professor
Maaret Paakkunainen, D. Sc.
Eeva Jernström, D. Sc.
Visiting Lecturer N.N.

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 (big data, digitalization issues), 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 contain 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 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):
No

Examination in Exam (Yes/No):
Yes

Assessment:
40 % Electronic Exam, 30 % Project Work, 30 % Other Homework.

Course Materials:
To be announced.

Places for exchange-students? (Yes, number/No):
Yes, 15 places for exchange students.

Places for Open University Students?(Yes, number/No):
Yes, 1-5

BJ02A0041: Master's Thesis and Seminar, 30 cp

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: Riina Salmimies

Note:

Replaces the courses BJ02A0040 Master's Thesis and Seminar, 30 ECTS and BJ02A0020 Diplomityö ja seminaari, 30 ECTS.
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 2017-2018 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, Finnish
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.
Examination in Examination schedule (Yes/No):
No
Examination in Moodle (Yes/No):
No
Examination in Exam (Yes/No):
No
Number of mid-term examinations:
0
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

BJ03A2040: Research Project Course in Water Treatment, 10 cp

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, Eveliina Repo

Note:

Replaces the course BJ02A4020 Methods in Green Chemistry.
Year:
M.Sc. (Tech.) 1
Period:
3-4
Teaching Language:
English
Teacher(s) in Charge:
Professor, D.Sc. (Tech.) Mika Sillanpää, Researcher, D.Sc. (Tech.) Eveliina Repo
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 4th period and experimental work will be carried out in Mikkeli after 4th period (during June).
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 202 h. Total work load 262 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
Number of mid-term examinations:
0
Assessment:
0-5, individual literature work 30%, project work and reporting 70%.
Course Materials:
Lecture materials. Moodle.
Prerequisites:
BJ03A1010 Introduction to Water Treatment
Places for exchange-students? (Yes, number/No):
No
Places for Open University Students?(Yes, number/No):
No

BJ03A2030: Water Treatment in Mining, 5 cp

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: Christian Wolkersdorfer

Note:
Suitable also for doctoral studies

Year:
M.Sc. (Tech.) 1
Period:
4
Teaching Language:
English
Teacher(s) in Charge:
Professor, Christian Wolkersdorfer
Aims:
By the end of the course, the student is expected to be able to -describe compositions of the mining wastewaters -describe conventional and novel water treatment methods used in mining industry -describe challenges related to mining waters -describe methods for analysis of mining waters.
Contents:
Students will learn the principles and novel insights in mining wastewater treatment. The course contains compulsory lectures and group work under supervision of the teachers. Individual literature review and seminar presentation are included.
Teaching Methods:
Lectures and group work 20 h. Seminar and literature work, independent workload about 110 h. Total workload about 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):
No
Examination in Moodle (Yes/No):
No
Examination in Exam (Yes/No):
No
Number of mid-term examinations:
0
Assessment:
0-5, literature work and seminar presentation 100%.
Course Materials:
Lecture notes. Moodle.
Prerequisites:
BJ03A1010 Introduction to Advanced Water Treatment.
Places for exchange-students? (Yes, number/No):
No
Places for Open University Students?(Yes, number/No):
This course has 1-5 places for open university students. More information on the web site for open university instructions.

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

KeSaD920: Green Process Technology, 20 - 26 cp

Validity: 01.08.2016 -

Form of study:

Type: Study module

Unit: LUT School of Engineering Science

Grading: Study modules 0-5,P/F

No course descriptions.

Choose a min. of 20 ECTS

BJ02A4041: Processing of Biomaterials, 5 cp

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: Katriina Mielonen, Sami-Seppo Ovaska

Note:

Replaces the course BJ02A4040
Suitable also for doctoral studies

Year:

M.Sc. (Tech.) 1

Period:

1

Teaching Language:

English

Teacher(s) in Charge:

D.Sc. (Tech.) Katriina Mielonen/edited 27.6.17/ml

Aims:

To give a basic introduction to modern pulp mills and forest biorefinery. Get familiar with basic process operation units and process flows.

Contents:

Raw materials, market. Fiber & Pulping (Basics).Chemical recovery.Cooking, bleaching. Main & side streams. Modern biorefinery. Pulps, hemicellulose, lignin. Biochemical and chemical conversion, thermochemical conversion.

Teaching Methods:

Lectures 28h Self studies 52h Project work 35h.

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):

Yes

Assessment:

0-5. Written examination 70%, project work 30%.

Course Materials:

Lecture material will be distributed via Moodle.

Prerequisites:

BJ01A5051 Biojalostamot

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

Yes, 15 places for exchange students.

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

This course has 1-5 places for open university students. More information on the web site for open university instructions.

BJ02A4051: Development of New Sustainable Products and Solutions, 5 cp

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-Seppo Ovaska, Katriina Mielonen

Note:

Replaces the course BJ02A4050 Biomaterials Design and Application
Suitable also for doctoral studies

Year:

M.Sc. (Tech.) 1

Period:

3

Teaching Language:

English

Teacher(s) in Charge:

D.Sc. (Tech.) Katriina Mielonen/Edited 27.6.17/ml

Aims:

To give an overview about the use of modern biochemicals such as nanocellulose, hemicellulose lignin in various applications.
After the completing the module, the student ought to:
- describe how various renewable resources is utilized in various applications.
- have an insight into material and molecular design and its role for the end product performance
- describe how biomaterials, and in particular wood derived, are used for example in food, pharmaceuticals, composites, and smart materials.

Contents:

Use of fibers, cellulose (derivatives), lignin in various non-paper applications. Fundamentals about biomaterial design, modification, synthesis and use in various products.. Chemical and mechanical modification, separation methods, mixing and drying methods. Product specification requirements and characterization methods.

Teaching Methods:

Lectures 28h Self studies 42h Project work 30h.

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):

Yes

Number of mid-term examinations:

0

Assessment:

0-5. 70% written examination 30% project work.

Course Materials:

Lecture material will be distributed via Moodle.

Prerequisites:

BJ02A4040 Processing of biomaterials

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

Yes, 5

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

This course has 1-5 places for open university students. More information on the web site for open university instructions.

BH50A1500: Bioenergy Technology Solutions, 6 cp

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

Note:

The course is suitable also for doctoral studies.

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 carbon trading, RES and energy efficiency, 2. understand the role and limitations of bioenergy use in Europe, 3. create a strategic vision for any country to use bioenergy, 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 biofuel refining, end-use technologies of biofuels in different sectors. 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):

This course has 1-5 places for open university students. More information on the web site for open university instructions.

BJ03A1020: Biological Waste Water Treatment, 5 cp

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

Note:

Starting from 2017-2018

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, energy efficiency of processes, 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, self-study (Moodle) 30 h, group works and literary works 52 h, preparation for exam and exam 20 h, total work load 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.

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

Yes, 15 places for exchange students.

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

This course has 1-5 places for open university students.

BJ02A1090: Environmental and Industrial Analytics, 5 cp

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, Eeva Jernström, Maaret Paakkunainen

Note:

Replaces courses: BJ03A1050 Environmental and Process Analytics & Monitoring and BJ02A1060 Prosessi- ja ympäristöanalytiikka.

Year:

M.Sc. (Tech.) 1

Period:

4

Teaching Language:

English

Teacher(s) in Charge:

Satu-Pia Reinikainen, D.Sc., Docent, Associate Professor
Maaret Paakkunainen, D. Sc.
Eeva Jernström, D. Sc.
Visiting Lecturer N.N.

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 (big data, digitalization issues), 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 contain 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 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):

No

Examination in Exam (Yes/No):

Yes

Assessment:

40 % Electronic Exam, 30 % Project Work, 30 % Other Homework.

Course Materials:

To be announced.

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

Yes, 15 places for exchange students.

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

Yes, 1-5

KeSoD100: Process Design, 20 - 32 cp

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

No course descriptions.

Choose a min. of 20 ECTS

BJ02A2041: Advanced Process Design, 5 cp

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: Esko Lahdenperä, Tuomas Koiranen

Year:

M.Sc. (Tech.) 1

Period:

2

Teaching Language:

English

Teacher(s) in Charge:

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

Number of mid-term examinations:

0

Assessment:

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

Course Materials:

Study material in Moodle. Other 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)

Prerequisites:

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

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

Yes. Prerequisities have to be fullfilled.

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

his course has 1-5 places for open university students. More information on the web site for open university instructions. Prerequisities have to be fullfilled.

BJ02A2020: Process Control, 5 cp

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: Pasi Peltoniemi, Satu-Pia Reinikainen, Olli Pyrhönen

Year:

M.Sc. 1

Period:

4

Teaching Language:

English

Teacher(s) in Charge:

Associate Professor, Docent, D.Sc. (Tech.) Satu-Pia Reinikainen
D.Sc. (Tech.) Pasi Peltoniemi

Aims:

After completing the module the student can - construct dynamic models for simple processes - explain the degrees of freedom in a given system - explain the principles of different process control strategies - apply different process control strategies for simple systems - explain the principles of statistical process control.

Contents:

Mathematics for control systems. Degrees of freedom. Feed-forward and feedback control. PID control. Basics of statistical process control methods for dynamic processes. Introduction to statistical control charts for quality and process control.

Teaching Methods:

Lectures and exercises 28 h, 4th period. Homework 50 h. Self-Study 52 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 70 %. Homework 30 %.

Course Materials:

To be announced.

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

Yes, 15 places for exchange students.

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

This course has 1-5 places for open university students. More information on the web site for open university instructions.

BJ02A2051: Process Intensification, 5 cp

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, seminars and exercises. In the seminars and exercises there will be discussion and problem solving about various topics and problems given by the lecturer.

Teaching Methods:

Lectures, seminars and exercises 28 h, 4th period. Self-study 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):

Yes

Assessment:

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

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

Yes, 15 places for exchange students.

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

This course has 1-5 places for open university students. More information on the web site for open university instructions.

BJ02A2061: Product Design, 5 cp

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

Number of mid-term examinations:

0

Assessment:

0-5, project work 100%.

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

Yes

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

This course has 1-5 places for open university students. More information on the web site for open university instructions.

BJ02A2011: Modelling of Unit Operations, 5 cp

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: Dipal Shah, Tuomo Kauranne

Note:

Replaces the course BJ02A2010 Modelling of Unit Operations, 6 op

Suitable also for doctoral studies

Year:

M.Sc. (Tech.) 1, M.Sc. (Tech.) 2 or Doctoral Studies

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:

Mechanistic mathematical models in research and design. Steady-state and transient models. Models in different stages of process life cycle. Parameter estimation. Simulation. Optimization. Scale-up. Modern modeling and simulation software.

Teaching Methods:

Lectures 24 h, exercises 14 h, 2nd period. Home assignments 70 h, self-study 46 h. Home assignments passed, no exam. Total workload 154 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

Number of mid-term examinations:

0

Assessment:

1-5.

Course Materials:

In Moodle

Prerequisites:

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

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

No

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

This course has 1-10 places for open university students. More information on the web site for open university instructions.

KeSaD210: Separation Technology, 20 - 26 cp

Validity: 01.08.2014 -
Form of study:
Type: Study module
Unit: LUT School of Engineering Science
Grading: Study modules 0-5,P/F

No course descriptions.

Choose a min. of 20 ECTS

BJ02A3010: Membrane Technology, 5 cp

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: Mika Mänttäri, Arto Pihlajamäki, Mari Kallioinen

Year:

M.Sc. (Tech.) 1

Period:

2 + intensive week (lectures)

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 extrapoints 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):

Yes, 15 places for exchange students.

BJ02A3030: Solid-Liquid Separation, 5 cp

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

Year:

M.Sc. (Tech.) 1

Period:

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 in solid-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 18 h, exercises 18 h, filtration laboratory work 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 examination 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, then number of places is not limited if prerequisites are OK.

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

This course has 1-5 places for open university students. More information on the web site for open university instructions.

BJ02A3040: Crystallization, 5 cp

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: Alexander Sokolov, Mehdi Hasan, Bing Han, Marjatta Louhi-Kultanen

Note:

Suitable also for doctoral studies

Year:

M.Sc. (Tech.) 2

Period:

INT week 43

Teaching Language:

English

Teacher(s) in Charge:

D.Sc. (Tech.) Bing Han, D.Sc. (Tech.) Mehdi Hasan

Aims:

After completing the module the student can: - explain the fundamentals of industrial crystallization and precipitation (solid-liquid equilibrium, supersaturation as driving force, crystallization methods, kinetics, population density, crystal size distributions, polymorphism, solvate and hydrate formation, mass transfer in crystallization, realtime process monitoring and process control) - explain crystallization as purification, separation and concentration unit operation, recovery method of chemicals from side streams - predict solubility of electrolyte solutions (multi-component solutions, Pitzer model) - explain principles of nanocrystallization - list and describe the operation of the most important industrial crystallizers - sizing of industrial crystallizers (batch process, continuous process by Mixed Suspension Mixed Product Removal (MSMPR) theory) - estimate process conditions for batch processes (cooling policy, seeding policy) - process simulation of cooling and evaporative crystallization processes (Aspen Plus) - characterization methods of crystalline end-products.

Contents:

Theory, operation and design of crystallizers. Crystallization as purification, separation and concentration method. Crystallization from solution and melt. Solid-liquid and solid-gas-liquid precipitation processes. Process Analytical Technology (PAT) in crystallization processes.

Teaching Methods:

Lectures 12 h, exercises 18 h, crystallization equipment demonstrations 2 h, intensive course week 43. Assignments and self-study 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):

No

Assessment:

0-5, assignments 100%.

Course Materials:

Davey, R. J., Garside, J., From Molecules to Crystallizers, Oxford, Oxford University Press, 2000. Lecture materials.

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

Yes, 5

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

Yes, 5

BJ02A3051: Hydrometallurgy, 5 cp

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 70 h. Total workload 129 h.

Examination in Examination schedule (Yes/No):

Yes

Examination in Moodle (Yes/No):

Maybe

Examination in Exam (Yes/No):

Maybe

Assessment:

0-5, Written examination 100%. 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):

Yes, no restrictions.

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

This course has 1-10 places for open university students. More information on the web site for open university instructions.

BJ02A3021: Chemical Separation Methods, 5 cp

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

Note:

Replaces the course BJ02A3020 Chemical Separation Methods, 6 ECTS

Year:

M.Sc. (Tech.) 1

Period:

2

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.

Examination in Examination schedule (Yes/No):

No

Examination in Moodle (Yes/No):

No

Examination in Exam (Yes/No):

No

Number of mid-term examinations:

0

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 work as well as other assignments.

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

Yes, 30, students in Chemical and Process Engineering / Chemical Engineering for Water Treatment / Prosessikemia degree programmes

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

Yes, 5.

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

This course has 1-5 places for open university students. More information on the web site for open university instructions.