Opasraportti

FTech - Courses in English for exchange students, Field of Process and Environmental Engineering (2020 - 2021)

University's new study guide for academic year 2020-2021 is published at https://opas.peppi.oulu.fi

The study guide includes information on degrees, curriculums, courses and course timetables. Course registrations are still done in Oodi.

If you have questions on information in the study guide, please contact the study field's Academic Affairs Service Team https://www.oulu.fi/forstudents/faculty-study-affairs

Courses in English for exchange students at the Field of Process and Environmental Engineering

This Course Catalogue lists courses taught in English that are available for exchange students at the Field of Process and Environmental Engineerint, Faculty of Technology, during academic year 2020-21.

When preparing your study plan please use the information provided under the **Courses** tab in this catalogue. Read carefully the information of each course you wish to take (language of instruction, target group, course content, timing, preceding studies, additional information etc.).

For information on the exchange application process please see www.oulu.fi/university/studentexchange. All exchange applicants must submit their exchange application through SoleMOVE by the deadline given, proposed study plan is attached to the on-line application.

Accepted exchange students are required to register to all courses. Course registration takes place once you have received your University of Oulu login information, this takes place close to the start of your exchange period. When registering you will be able to find detailed information on teaching and schedule under the **Instruction** tab.

Teaching periods for 2020-21
Autumn term 2020
Period 1: Sept 1 - Oct 25, 2020
Period 2: Oct 26 – Dec 18, 2020

Spring term 2021
Period 3: Jan 5 – March 14, 2021
Period 4: March 15 – May 9, 2021

For arrival and orientation dates see www.oulu.fi/university/studentexchange/academic-calender

Any questions on courses at the Field of Process and Environmental Engineerint, Faculty of Technology should be addressed to:

Marita Puikkonen
study.technology(at)oulu.fi

Further information on application process and services for incoming exchange students:
www.oulu.fi/university/studentexchange or international.office(at)oulu.fi

Tutkintorakenteisiin kuulumattomat opintokokonaisuudet ja -jaksot

477607S: Advanced Control and Systems Engineering, 5 op
488305S: Advanced Course for Biotechnology, 5 op
477223S: Advanced Process Design, 5 op
488214S: Air Pollution Control Engineering - Practical Solutions, 5 op
477508S: Automation in Metallurgical Industry, 5 op
477713S: Automation in Mineral Processing, 5 op
900013Y: Beginners' Finnish Course 1, 3 op
900053Y: Beginners' Finnish Course 2, 5 op
488321S: Bioreactor technology, 5 op
477204S: Chemical Engineering Thermodynamics, 5 op
477209S: Chemical Process Simulation, 5 op
477123S: Chemical processing of biomasses, 5 op
477128S: Circular Bioeconomy, 5 op
477525S: Computational intelligence in automation, 5 op
477624S: Control System Methods, 5 op
900054Y: Conversational Skills in Finnish, 3 op
488507S: Energy Systems Engineering, 5 op
477502A: Experiment design and analysis, 5 op
488127S: Field measurements, site investigations and geotechnical tests, 5 op
477305S: Flow Dynamics, 5 op
477052A: Fluid Mechanics, 5 op
488504S: Fundamentals of nuclear energy, 5 op
488140S: Groundwater modelling and management, 5 op
488134S: Hydrogeology and groundwater engineering, 5 op
488102A: Hydrological Processes, 5 op
488203S: Industrial Ecology, 5 op
900015Y: Intermediate Finnish Course 1, 5 op
900016Y: Intermediate Finnish Course 2, 5 op
488052A: Introduction to Bioproduct and Bioprocess engineering, 5 op
477323A: Mass and Heat Transfer, 5 op
477221A: Material and Energy Balances, 5 op
477124S: Mechanical processing of biomasses, 5 op
477506S: Modelling and Control of Biotechnical Processes, 5 op
477308S: Multicomponent Mass Transfer, 5 op
477306S: Non-ideal Reactors, 5 op
477625S: Power Plant Automation, 5 op
477203A: Process Design, 5 op
477524S: Process Optimization, 5 op
477309S: Process and Environmental Catalysis, 5 op
477501A: Process dynamics, 5 op
488209S: Renewable Energy, 5 op
477312S: Science and Professional Ethics, 5 op
477304A: Separation Processes, 5 op
477523S: Simulation, 5 op
488501S: Smart Grid I: Integrating renewable energy sources, 5 op
488502S: Smart Grid II: Smart buildings/smart customers in the smart grid, 5 op
488503S: Smart Grid III: Smart energy networks, 5 op
900027Y: Special Course in Finnish: Writing Skills, 3 op
900017Y: Survival Finnish, 2 op
488402S: Sustainable Development, 5 op
488506S: Sustainable Urban Energy, 5 op

477415S: Thermodynamic and process modelling in metallurgy, 5 op
488146S: Urban water management, 5 op
488110S: Water and Wastewater Treatment, 5 op

Opintojaksojen kuvaukset

Tutkintorakenteisiin kuulumattomien opintokokonaisuuksien ja -jaksojen kuvaukset

477607S: Advanced Control and Systems Engineering, 5 op

Voimassaolo: 01.08.2005 -
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Field of Process and Environmental Engineering
Arvostelu: 1 - 5, pass, fail
Opettajat: Ikonen, Mika Enso-Veitikka
Opintokohteen kielet: Finnish
Leikkaavuudet:

470444S Advanced Control Methods 6.0 op

ECTS Credits:
5 ECTS, 135 h of work
Language of instruction:
Finnish (available in English as a book exam: students will receive materials to study and take an final exam based on those materials)
Timing:
Period 3
Learning outcomes:
After completing the course the student can design the model based control systems, can formulate and solve state estimation problems, and discover research trends in control and systems engineering.
Contents:
1. Model-based control: as DMC, QDMC; GPC. 2. State estimations: as Kalman filtering and particle filters. 3. Active research directions (elected annually).
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures and demonstration exercises
Target group:
M.Sc. students in process and environmental engineering
Prerequisites and co-requisites:
The courses 477621A Control system analysis, 477622A Control system design and 477624S Control system methods recommended beforehand
Recommended or required reading:
Materials distirbuted during the contact teaching and through the course web pages.
Assessment methods and criteria:
Exam and homework
Grading:
Numerical grading scale 1.5 or fail
Person responsible:
Professor Enso Ikonen

488305S: Advanced Course for Biotechnology, 5 op

Voimassaolo: 01.08.2005 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Process and Environmental Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Johanna Panula-Perälä

Opintokohteen kielet: English

Leikkaavuudet:

480450S Bioprocesses III 5.0 op

ECTS Credits:
5 ECTS /135 hours of work
Language of instruction:
English
Timing:
The course is held in spring semester during period 3. It is recommended to complete the course in the 4th (1st Master's) year.
Learning outcomes:
After completing this course, the student will be able to describe the most important techniques - both up- and downstream - in biotechnological production of proteins.
Contents:
Microbial homologous and heterologous protein production. Unit operations in product recovery and purification. Biocatalyst screening and optimization. Scale-up and intensification of bioprocesses.

Mode of delivery:
Blended teaching.
Learning activities and teaching methods:
Lectures 30 h / homework 48 h / self-study 57 h.
Target group:
Master students in bioprocess engineering. Master students in process engineering, environmental engineering and biochemistry with required prerequisites.
Prerequisites and co-requisites:
Courses 488212A Fundamentals of Catalysis or 488309A Biocatalysis, 488052A Introduction to Bioproduct and Bioprocess Engineering and 488321S Bioreactor technology, or respective knowledge.

Recommended or required reading:
Will be announced at the lectures.
Assessment methods and criteria:
Lectures, exercises and report. Grade will be composed of homework exercises and reports or final examination.
Grading:
The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.
Person responsible:
TkT Johanna Panula-Perälä
Working life cooperation:
No

477223S: Advanced Process Design, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Process and Environmental Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Ahola, Juha Lennart

Opintokohteen kielet: English

Leikkaavuudet:

477206S Advanced Process Design 6.0 op

ECTS Credits:
5 ECTS /135 hours of work
Language of instruction:
English
Timing:
Spring, periods 3 and 4
Learning outcomes:
The student is able to produce a preliminary chemical process concept. She/he can apply systematic process synthesis tools, chemical process simulation tools and whole process performance criteria in the conceptual process design phase. Furthermore, the student is able to produce process design documents. The student will acquire skills how to work as a member in an industrial chemical process design project. She/he will experience by team work the hierarchical character of the conceptual process design, the benefits of the systematic working methods and the need to understand the whole process performance when optimal design is sought. The student understands the importance of innovation and creative work.
Contents:
Conceptual process design and hierarchical decision making. Heuristics of process design. Design methodology: synthesis, analysis and evaluation. Design cycle. Performance evaluation of the chemical processes. Team work and meetings.
Mode of delivery:
Design projects in small groups
Learning activities and teaching methods:
Project meetings 10h and project group work 120h
Target group:
Master's students of process and environmental engineering
Prerequisites and co-requisites:
Learning outcomes of 477203A Process Design or similar knowledge
Recommended or required reading:
Seider, W.D., Seider, J.D. and Lewin, D.R. Product and process design principles: Synthesis, analysis and evaluation. John Wiley & Sons, 2004. (Parts) ISBN 0-471-21663-1

Assessment methods and criteria:
Project work with oral and written reporting. Read more about the course assessment and grading systems of the University of Oulu at https://www.oulu.fi/forstudents/assesment-criteria
Grading:
The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.
Person responsible:
University Lecturer Juha Ahola

488214S: Air Pollution Control Engineering - Practical Solutions, 5 op

Voimassaolo: 01.08.2019 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Process and Environmental Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Satu Pitkäaho

Opintokohteen kielet: English

ECTS Credits:
5 ECTS credits / 135 hours of work
Language of instruction:
English
Timing:
Implementation in autumn semester during 2 nd period first time in Autumn term 2020.
Learning outcomes:

Student is able to explain what kind of air emissions originate from different industrial and energy production sectors. Student deepens knowledge obtained in 488213A course and is able to apply it to different practical emission problems. She/he is able to comprehensively describe, choose, design and optimize emission control technologies. Student understands essential regulations and laws concerning emission control.
Contents:
Principles of air pollution control equipment and their use in real applications. Emission control case studies in industry and energy production sector. Air pollution related regulations and laws.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 30 h, exercises 12 h, homework 8 h, teamwork presentations 10 h, and self-study 75.
Target group:
Master's degree students of the Process and Environmental Engineering study programmes.
Prerequisites and co-requisites:
488213A Ilmansuojelutekniikan perusteet
Recommended or required reading:
Materials in the Optima environment. de Nevers; N.: Air Pollution Control Engineering. 2nd ed. McCraw-Hill 2000. 586 pp
Additional literature: Singh, H. B.: Composition, Chemistry, and Climate of the Atmosphere. New York 1995. 527 pp.; Bretschneider, B. & Kurfurst, J.: Air Pollution Control Technology. Elsevier, Amsterdam 1987. 296 pp.; Hester, R. E. & Harrison, R. M.: Volatile Organic Compound in the Atmosphere. Issues in Environmental Science and Technology. Vol. 4. Bath 1995; Hester, R. E. & Harrison, R. M.: Waste Incineration and the Environment. Issues in Environmental Science and Technology. Vol 4. Bath 1995.
Assessment methods and criteria:
Written final exam or intermediate exams.
Read more about the course assessment and grading systems of the University of Oulu at https://www.oulu.fi/forstudents/assesment-criteria

Grading:
The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.
Person responsible:
Satu Pitkäaho ja Esa Turpeinen
Working life cooperation:
No
Other information:
Replaces the course 488204S Air Pollution Control Engineering.

477508S: Automation in Metallurgical Industry, 5 op

Voimassaolo: 01.08.2005 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Process and Environmental Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Jari Ruuska

Opintokohteen kielet: English

ECTS Credits:
5 ECTS /135 hours of work
Language of instruction:
English
Timing:
Implementation in the 4th period (spring term).
Learning outcomes:
After the course, the student knows the management and control problems in metallurgical industry and can choose between the main modelling and control methods to solve them. He can apply the skills of earlier studies in analysing the control of separate processes and larger process lines and can estimate technical and economic effects of automation in metallurgical industry.
Contents:

Modelling and control examples of steel production processes: coking, sintering, blast furnace, steel converter, continuous casting, and rolling mill. Model solutions by special-purpose simulators. Also some special measurements are introduced.
Mode of delivery:
Lectures, practical group work using simulators.
Learning activities and teaching methods:
Lectures during one period.
Target group:
Master's students in the study programmes of Process or Environmental Engineering/study option Automation Technology. Exchange and other international students.
Recommended or required reading:
Lecture notes in English. Everyone does his/her material during the course in the form of lecture diary that is returned and evaluated at the end. Group work uses the simulator in the Internet.
Assessment methods and criteria:
Continuous evaluation: lectures, lecture diaries, test, and practical work using simulation.
Read more about assessment criteria at the University of Oulu webpage: https://www.oulu.fi/forstudents/assesment-criteria .
Grading:
The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.
Person responsible:
Jari Ruuska
Working life cooperation:
No

477713S: Automation in Mineral Processing, 5 op

Voimassaolo: 01.08.2013 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Process and Environmental Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Markku Ohenoja

Opintokohteen kielet: Finnish

Leikkaavuudet:

477510S	Automation in Mineral Processing	5.0 op
477724S	Numerical Mine Modelling	5.0 op

ECTS Credits:
5 ECTS /135 hours of work
Language of instruction:
English
Timing:
Implementation in the 4th period (spring term).
Learning outcomes:
The target is to give the students the skills to understand and develop models for minerals processing and apply these models in process monitoring, optimization and control.

Contents:
Models for processes like crushing, grinding, flotation, leaching, separation etc. Examples how to use these models in process control and what kind of benefits can be drawn from their use.

Mode of delivery:
Lectures and demonstrations
Learning activities and teaching methods:
Lectures during one period
Target group:
Master's students in process and environmental engineering. Exchange students.
Prerequisites and co-requisites:
Basic knowledge in minerals processing and control engineering.
Recommended or required reading:

Lecture notes in English
Assessment methods and criteria:
Lecture exams. Final exam is also possible.

Grading:
The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.
Person responsible:
D.Sc. (Tech.) Markku Ohenoja
Working life cooperation:
No

900013Y: Beginners' Finnish Course 1, 3 op

Voimassaolo: 01.08.1995 -

Opiskelumuoto: Language and Communication Studies

Laji: Course

Vastuuyksikkö: Languages and Communication

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay900013Y Beginners' Finnish Course 1 (OPEN UNI) 2.0 op

Proficiency level:
A1 (target level A1.2)
Status:
The course is intended for the international students in every faculty of Oulu University.
Required proficiency level:
A1.1, Completion of the Survival Finnish course (900017Y) or the equivalent language skills.
ECTS Credits:
3 ECTS credits
Language of instruction:
As much Finnish as possible; English will be used as a help language.
Timing:
-
Learning outcomes:
By the end of the course the student can understand and use some familiar and common everyday expressions relating to her/himself and everyday situations. S/he can interact in a simple way provided the other person talks slowly and clearly and is willing to help. The student is able to read short simple texts and messages dealing with familiar topics. S/he also deepens her/his understanding of the Finnish language and communication styles.
Contents:
This is lower elementary course which aims to help students to learn communication skills in ordinary everyday situations. During the course, students broaden their vocabulary and knowledge of grammar and principles of pronunciation. They also practise to understand easy Finnish talk about everyday subjects, and reading and writing short and simple texts/messages.

The topics and communicative situations covered in the course are: talking about oneself, one's family, studies and daily routines, as well as asking about these things from other person; expressing opinions; food, drink and transactions in the grocery; accommodation and describing it; colours and adjectives.

The structures studied are: verb types, basics of the change of the consonants k, p and t in verbs and nouns, basics of the partitive and genitive cases, possessive structure, some declension types for nouns (word types) and the basics of the local cases.
Mode of delivery:
Contact teaching and guided self study
Learning activities and teaching methods:
Lessons 2 times a week (26 h, including the final exam) and guided self study (55 h)
Target group:
International degree and post-graduate degree students, exchange students and the staff members of the University.
Prerequisites and co-requisites:

Completion of the Survival Finnish Course
Recommended optional programme components:
-
Recommended or required reading:
Kuparinen, K. & Tapaninen, T. Oma suomi 1 (chapter 2 - 5)
Assessment methods and criteria:
Regular and active participation in the weekly lessons (twice a week), homework assignments and written exam at the end of the course will be observed in assessment.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Grading scale is 1-5.
Person responsible:
Anne Koskela
Working life cooperation:
-
Other information:
Sign-up in WebOodi or Tuudo. The course will start right after the Survival Finnish course.

900053Y: Beginners' Finnish Course 2, 5 op

Voimassaolo: 01.08.1995 -

Opiskelumuoto: Language and Communication Studies

Laji: Course

Vastuuyksikkö: Languages and Communication

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay900053Y	Beginners' Finnish Course 2 (OPEN UNI)	4.0 op

Proficiency level:
A1.3
Status:
International degree and post-graduate degree students, exchange students and the staff members of the University.
Students of the Oulu University of Applied Sciences (OAMK) students and OAMK's international and exchange students may also participate to this cross-institutional study. The quota principle is as follows: at least two OAMK students in a course and if there are more places, they are filled according to the queuing principle.
See more information for OAMK students https://www.oulu.fi/forstudents/crossinstitutionalstudy.
Required proficiency level:
A1.2, completion of the Beginners' Finnish course 1 (900013Y) or the equivalent language skills.
ECTS Credits:
5 ECTS credits
Language of instruction:
As much Finnish as possible; English will be used as a help language.
Timing:
-
Learning outcomes:
By the end of the course the student can understand and use some very common everyday expressions and sentences. S/he can communicate in easy and routine tasks requiring a simple and direct exchange of information on familiar everyday matters. The student understands different kinds of short texts. S/he can for example locate important information in them. In addition, s/he has acquired more detailed knowledge of the language and culture.
Contents:
This is a post-elementary course. During the course students learn more about communication in ordinary everyday situations in Finnish. They also extend their vocabulary and knowledge of grammar. Students practise understanding simple Finnish talk and short texts.

The topics and communicative situations covered in the course are: talking about weather, carrying out transactions in clothing stores and at the doctor's, asking about location, asking for help/favours, expressing how you are feeling, writing an invitation and email; talking about past, describing people and things; seasons, the names of the months, travelling, vehicles, body parts, adjectives, food, drink and parties.
The structures studied are: the local cases, more about the change of the consonants k, p and t, more declension types for nouns (word types), nominative plural (basic form plural), basics of the imperfect (past tense of verbs), basics of the object cases, some postposition structures, some sentence types (predicative and necessity sentences).

Mode of delivery:
Contact teaching and quided self study
Learning activities and teaching methods:
Lessons 2 times a week (52 h, including the tests) and guided self study (83 h)
Target group:
International degree and post-graduate degree students, exchange students and the staff members of the University.
Students of the Oulu University of Applied Sciences (OAMK) students and OAMK's international and exchange students may also participate to this cross-institutional study. The quota principle is as follows: at least two OAMK students in a course and if there are more places, they are filled according to the queuing principle.
See more information for OAMK students https://www.oulu.fi/forstudents/crossinstitutionalstudy.
Prerequisites and co-requisites:
Completion of the Beginners' Finnish Course 1 or the equivalent language skills.
Recommended optional programme components:
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Recommended or required reading:
Kuparinen, K. & Tapaninen, T. Oma suomi 1 (chapters 6 - 10)
Assessment methods and criteria:
Regular and active participation in the weekly lessons (twice a week), homework assignments and tests will be taken into consideration in the assessment.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Grading scale is 1-5.
Person responsible:
Arja Haapakoski
Working life cooperation:
-
Other information:
Sign-up in WebOodi or Tuudo. Staff members in staff training portal.

488321S: Bioreactor technology, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Process and Environmental Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Ville-Hermanni Sotaniemi

Opintokohteen kielet: English

Leikkaavuudet:

488304S Bioreactor Technology 6.0 op

ECTS Credits:
5 ECTS /135 hours of work
Language of instruction:
English
Timing:
The course is held in autumn semester during period 2. It is recommended to complete the course in the 4th (1st Master's) year.
Learning outcomes:

After completing this course, the student will be able to verbally describe the most common equipment, materials and methods related to biotechnological processes, microbial growth and cultivation and sterilization. The student will be able to mathematically describe microbial growth and product formation, enzyme catalysis and bioreactor performance. The student will also be able to use these mathematical tools to plan and analyze bioprocesses.

Contents:
Biotechnological process: General process schemes, batch, fed-batch and continuous processes, biocatalysts and raw materials. Reactor design and instrumentation. Sterilization: kinetics of heat inactivation and practical implementation of sterilization methods. Mathematical description and quantification of the function of biocatalysts. Monod and Michaelis-Menten models, reaction rates and their determination. The lag phase of growth, cellular maintenance, cell death. Kinetics of product and by-product formation. Kinetics of oxygen and heat transfer. Oxygen and heat balances: significance and calculations. Mixing and power consumption. Scale-up and scale-down.

Mode of delivery:
Blended teaching.

Learning activities and teaching methods:
Lectures 40 h / exercises 4 h / homework 29 h / self-study 62 h.

Target group:
Master students in bioprocess engineering. Master students in process engineering, environmental engineering and biochemistry with required prerequisites.

Prerequisites and co-requisites:
The previous bachelor level courses in Process or Environmental Engineering (especially 488212A Fundamentals of Catalysis or 488309A Biocatalysis, 488052A Introduction to Bioproduct and Bioprocess Engineering) or respective knowledge.

Recommended or required reading:
Lectures: Lecture handouts; Doran, P. M. Bioprocess engineering principles. Academic Press. London, 2012. Supplementary material: Villadsen J., Nielsen J., Liden G. Bioreactor engineering principles. Springer Verlag, 2011. Shuler ML., Kargi F. Bioprocess engineering basic consepts. 2 ed. Pearson. 2002 and 2014.

Assessment methods and criteria:
Lectures, exercises, final exam, homework. Grade will be composed of final exam, exercises and homework.

Grading:
The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:
DI Ville Sotaniemi

Working life cooperation:
No

477204S: Chemical Engineering Thermodynamics, 5 op

Voimassaolo: 01.08.2005 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Process and Environmental Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Tanskanen, Juha Petri

Opintokohteen kielet: Finnish

ECTS Credits:
5 ECTS /135 hours of work

Language of instruction:
Finnish

Timing:
Period 1 (autumn term)

Learning outcomes:
By completing the course, the student understands classical thermodynamics from a chemical engineering viewpoint. Especially she/he can explain the pVT behaviour of pure substances and understands the thermodynamic properties of mixtures. The student can classify the thermodynamic models describing, for example, liquid mixtures. The student can select appropriate models for gas, vapour and liquid phases. In addition, the student can solve process models, phase equilibrium and chemical reaction equilibrium problems, and more generally, is able to evaluate chemical processes using thermodynamic analysis tools.

Contents:
Mass and energy balances, pVT behaviour of pure substances, thermodynamic properties of fluids, chemical reaction equilibrium, vapour/liquid equilibrium, introduction to the use of Aspen Plus in the calculation of a thermodynamic equilibrium state, calculation of thermodynamical state functions, thermodynamic analysis of processes.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 46 h and self-study 87 h
Target group:
Students in the study options of Chemical Engineering, and Bioproducts and bioprocesses.
Prerequisites and co-requisites:
Essential contents of 477401A Thermodynamic equilibria course, or equivalent knowledge on the basic concepts of thermodynamic equilibria.
Recommended or required reading:
Lecture handout. Material given during the lectures. Additional literature, Smith, J.M. & Van Ness, H.C.: Introduction to Chemical Engineering Thermodynamics. McGraw-Hill, 2005. (7th ed.) ISBN 0-07-124708-4

Assessment methods and criteria:
Combination of a final exam and home exercises.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.
Person responsible:
Dr Jani Kangas
Working life cooperation:
No
Other information:
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477209S: Chemical Process Simulation, 5 op

Voimassaolo: 01.08.2011 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Process and Environmental Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Tanskanen, Juha Petri

Opintokohteen kielet: English

ECTS Credits:
5 ECTS /135 hours of work
Language of instruction:
English
Timing:
Autumn, periods 1-2
Learning outcomes:
The student has the ability to convert a process flow diagram into a form compatible with process simulation software. She/he has skills to evaluate realistic process conditions in a typical chemical process. The student can apply proper thermodynamic property models for simulation purposes. She/he can name the advantages and disadvantages of using the sequential modular solving approach in chemical process modelling and simulation. She/he is capable of solving a computer simulation case for a typical chemical process. The student is able to analyze the simulation results with respect to realistic values.
Contents:
Thermodynamic property models and databanks. Degrees of freedom analysis. Steady-state simulation. Sequential modular, and equation-oriented approaches in simulation. Numerical solving methods. Optimization with a simulation software. Heuristics for chemical process simulation.
Mode of delivery:
Face-to-face teaching, introductory examples and group exercises with a process simulation software.
Learning activities and teaching methods:
Guided exercises 46 h and group work 89 h.

Target group:
Master's students in Chemical Engineering study option.
Prerequisites and co-requisites:
477204S Chemical Engineering Thermodynamics or equivalent knowledge.
Recommended optional programme components:
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Recommended or required reading:
Material distributed on lectures. Additional literature, Turton, R., Bailie, R.C., Whiting, W.B. & Shaeiwitz, J.A.: Analysis, synthesis, and design of chemical processes. 3rd Ed. Prentice Hall. (Parts) ISBN 0-13-512966-4.
Assessment methods and criteria:
Group exercise reports and a simulation study exam performed individually.
Read more about the course assessment and grading systems of the University of Oulu at www.oulu.fi/english/studying/assessment.
Grading:
Numerical grading scale, 0-5. Zero stands for a fail.
Person responsible:
Dr Jani Kangas
Working life cooperation:
No
Other information:
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477123S: Chemical processing of biomasses, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Process and Environmental Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Elisa Koivuranta

Opintokohteen kielet: English

Leikkaavuudet:

477104S	Chemical Processing of Biomasses	3.0 op

ECTS Credits:
5 ECTS /133 h of work
Language of instruction:
English
Timing:
Implementation in autumn period 1
Learning outcomes:
Upon completion of the course, a student should be able to explain the value chain of chemical processing of renewable lignocellulosic raw materials to pulp and different end-products. A student is able to identify lignocellulosic raw material sources, their properties, their main components and utilization potential of components. The student also identifies the unit operations of chemical pulping processes, can explain their operational principles and their objectives in the process and their role in end product properties. Besides cellulose fibre production, the student get familiar with novel bioproduct applications.
Contents:
Lignocellulosic raw materials, fundamentals of chemical pulping, recovering of chemicals in kraft pulping, fiberline in kraft pulping, side products, environmental aspects and novel applications.
Mode of delivery:
Blended teaching.
Learning activities and teaching methods:
Lectures and exercises max. 20 h, homework and self-study 113 hours.
Target group:
Students interested in bioeconomy.
Prerequisites and co-requisites:
488052A Introduction to Bioproduct and Bioprocess Engineering is recommended.
Recommended optional programme components:
-

Recommended or required reading:
Book series: Fapet Oy. Papermaking Science and Technology, book 6: Chemical pulping Part 1 and Part 2, book 20: Biorefining of Forest Resources. Lecture materials and other materials that will be announced at the lectures.
Assessment methods and criteria:
This course utilizes continuous assessment including intermediate exam with web learning and homework. Read more about the course assessment and grading systems of the University of Oulu at https://www.oulu.fi/forstudents/assesment-criteria

Grading:
The course utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.
Person responsible:
Elisa Koivuranta
Working life cooperation:
A visit/excursion to the local pulp mill and/or visiting lecturers from the industry, when feasible.
Other information:
-

477128S: Circular Bioeconomy, 5 op

Voimassaolo: 01.08.2019 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Process and Environmental Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Elisa Koivuranta

Opintokohteen kielet: English

Leikkaavuudet:

ay477128S	Circular Bioeconomy (OPEN UNI)	5.0 op
477125S	Recycling of bioproducts	5.0 op
477106S	Recycled Fiber Processes	3.0 op

ECTS Credits:
5 cr
Language of instruction:
English
Timing:
Implementation in the spring period 3.
Learning outcomes:
Upon completion of the course, a student should be able to recognize the incentives for the recycling of bioproducts and residues from forest industry. Student is familiarized with circular bioeconomy at the state-of-art level. Student is able to identify the challenges (properties, transportation ect.) of raw materials and their processing, can propose solutions and has ability to review the sustainability of final products.
Contents:
Reuse, recycling and utilization of bioproducts and side streams of forest industry in accordance with principles of circular bioeconomy. The properties and processing of raw material. Novel applications in circular bioeconomy.
Mode of delivery:
Lectures, group meetings and project work.
Learning activities and teaching methods:
Work load in the course is totally 133h. The number of lectures can vary but project working is main activities in the course.
Target group:
Students interested in circular bioeconomy.
Prerequisites and co-requisites:
488052A Introduction to Bioproduct and Bioprocess Engineering is recommended.
Recommended or required reading:
Lecture materials and other materials that will be announced at the lectures.
Assessment methods and criteria:
The assignment and seminar. More information about assessment methods is given during the course.
Grading:

The course utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.
Person responsible:
Elisa Koivuranta
Working life cooperation:
Visiting lecturers from the industry, when feasible.
Other information:
This Course replace course 477125S Recycling of bioproducts, 5 cr.

477525S: Computational intelligence in automation, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Process and Environmental Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Aki Sorsa

Opintokohteen kielet: Finnish

Leikkaavuudet:

477505S	Fuzzy-neuromethods in Process Automation	4.0 op

ECTS Credits:
5 ECTS / 135 hours of work
Language of instruction:
Finnish and English
Timing:
Implementation in the spring term, on the 3rd period. Recommended for 4th year students (first M.Sc. year)
Learning outcomes:
After the course the student is capable of explaining the concepts of intelligent systems and operation principles of fuzzy set systems, neural networks, neuro-fuzzy systems and evolutionary computation. The student has skills to construct and tune fuzzy models in Matlab-Simulink environment and to explain the operation of these models. The student is able to explain in an integrating way the principle concepts of neural computing and construct neural network models in Matlab-Simulink environment. The student is able to explain the operation principles of genetic algorithms and to use them in tuning of fuzzy set systems and neural network models.
Contents:
Fuzzy logic and fuzzy set systems, fuzzy calculus, fuzzy modelling and control, neural computation, neuro-fuzzy methods and evolutionary computation.
Mode of delivery:
Tuition is implemented mainly as face-to-face teaching.
Learning activities and teaching methods:
The amount of guided teaching is 40 hrs including lectures, exercises and a possible seminar presentation. As a self-study, students carry out homework, case study and seminar presentation preparation.
Target group:
M.Sc. students in process and environmental engineering, machine engineering, computer engineering and industrial engineering and management.
Prerequisites and co-requisites:
No specific prerequisites, but skills for simulation, and programming in Matlab are a benefit.
See "Recommended optional programme components" below.
Recommended optional programme components:
Courses Simulation, and Programming in Matlab reinforce abilities for the exercises and the case study.
Recommended or required reading:
Lecture notes and materials. Other literature.
Assessment methods and criteria:
This course uses continuous assessment that includes homework, classroom or home exams, case study and a possible seminar presentation.
Read more about the course assessment and grading systems of the University of Oulu at www.oulu.fi/english/studying/assessment
Grading:
The course unit uses a numerical grading scale 1-5. In the numerical scale zero stands for a fail.
Person responsible:
Aki Sorsa

Working life cooperation:
No

477624S: Control System Methods, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Process and Environmental Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: István Selek

Opintokohteen kielet: Finnish

Leikkaavuudet:

477614S	Control System Methods	3.0 op
477605S	Digital Control Theory	4.0 op

ECTS Credits:
5 ECTS / 135 hours of work
Language of instruction:
English

Timing:
Period 1 (autumn term)
Learning outcomes:
After completing the course, one understands the relevance and building blocks of model-based control design and system analysis. Relying on data-driven approaches, this course provides strong foundations for digital control design considering real-life applications.

Contents:
1. Control theory of linear time-invariant (LTI) systems in discrete-time (digital control). State-space representation and system analysis in time domain. Controllability, observability and related concepts. Relation of the static state feedback with PID control. Stability in Lyapunov sense. 2. Basics of LTI model identification using data. Model order reduction, model uncertainty. The relevance of LTI theory in the control of nonlinear systems. 3. Laboratory exercises with the Valmet DNA automation system.
Mode of delivery:
Regular lectures
Learning activities and teaching methods:
Lectures and exercises including guided computer simulations
Target group:
M.Sc. students in process and environmental engineering
Prerequisites and co-requisites:
The courses 477621A Control system analysis and 477622A Control system design are recommended beforehand.
Recommended or required reading:
Lecture handout;
Dorf, R. (2010) Modern Control Systems. Prentice-Hall, New York, 1104 s,
Ogata, K (2002) Modern Control Engineering. Prentice-Hall, New York, 964 s.,
Åström, K & Murray, R. (2009) Feedback Systems, An Introduction for Scientists and Engineers. Princeton University Press, New Jersey, 396 s.,
Landau, I. & Zito, G. (2005) Digital Control Systems, Springer. 485 pp.
Åström, K.J. & Wittenmark, B. (1984, 1997) Computer Controlled Systems: Theory and Design. Prentice-Hall International.
Assessment methods and criteria:
Completition of homeworks and final (written) exam.
Grading:
Numerical grading scale 1-5 or fail.
Person responsible:
István Selek
Working life cooperation:
No

900054Y: Conversational Skills in Finnish, 3 op

Voimassaolo: 01.08.1995 -
Opiskelumuoto: Language and Communication Studies
Laji: Course
Vastuuyksikkö: Languages and Communication
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Proficiency level:
B1/B2 , according to the Common European Framework.
Status:
The course is intended for the international students in every faculty at the University of Oulu. Students of the Oulu University of Applied Sciences (OAMK) may also participate to this cross-institutional study. See courses, student quota and applying for OAMK students https://www.oulu.fi/forstudents/crossinstitutionalstudy.
Required proficiency level:
A2.2
Completion of Intermediate Finnish 2 (900016Y) or the equivalent language skills.
ECTS Credits:
3 ECTS credits
Language of instruction:
Finnish
Timing:
-
Learning outcomes:
By the end of the course the student can interact with a degree of fluency (and spontaneity) that makes regular interaction with native speakers quite possible. S/he can describe and explain (clearly and in detail) on a wide range of objects, experiences and events, dreams, hopes and ambitions. The student can bring out opinions, give reasons and explanations for them and explain a viewpoint on a topical issue giving the advantages and disadvantages of various options. S/he is also able to give a (clear) prepared presentation and answer the questions posed by the audience.
Contents:
During the course students strengthen their communication skills in formal and informal situations. The goal is to activate the student's Finnish skills and encourage him/her to use them in different situations. There will be various types of situational dialogue, conversation and listening exercises in the course. In addition, students will conduct a short survey which will also be reported to other students in the class.
Mode of delivery:
Contact teaching and guided self study
Learning activities and teaching methods:
Lessons twice a week (28-30 h), group work (15 h) and guided self study (36 h)
Target group:
International degree and post-graduate degree students, exchange students and the staff members of the University. Students of the Oulu University of Applied Sciences (OAMK) may also participate to this cross-institutional study. See courses, student quota and applying for OAMK students https://www.oulu.fi/forstudents/crossinstitutionalstudy.
Prerequisites and co-requisites:
Completion of Intermediate Finnish 2 (900016Y) or equivalent skills
Recommended optional programme components:
-
Recommended or required reading:
Will be provided during the course.
Assessment methods and criteria:
To pass the course, students must attend class on a regular basis and complete group work tasks and homework assignments.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Grading is on a pass/fail basis.
Person responsible:
Anne Koskela
Working life cooperation:

-

Other information:
Sign-up in WebOodi or Tuudo. Staff members in in staff training portal.

488507S: Energy Systems Engineering, 5 op

Voimassaolo: 01.08.2019 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Process and Environmental Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Eva Pongracz

Opintokohteen kielet: English

ECTS Credits:
5 cr/135 hours of work
Language of instruction:
English
Timing:
Autumn, period 1
Learning outcomes:
After the course, the student is familiar with the measures and dimensions of macro-level energy production and consumption. The student will know the energy measures and able to apply correctly the units of energy. The student will gain fluency in finding, downloading, processing and visualizing energy statistics. The student will know the expectations from energy conversion and distribution systems, energy storage systems, and the management of the efficient use of energy in buildings, manufacturing, and processing systems. The student will also understand the seasonality of different energy needs and energy generation from renewable energy sources (RES) as well as will be able to calculate the required size of installations that can cover the energy needs of different targets. The student will also gain understanding of the secondary effects of energy usage from a local environmental impact, regional and national economic impact, and global climate change perspective. The student can also calculate total net energy needs, total energy from RES, % of total net energy covered by RES, total balance in primary energy units. The student can also correctly apply EROI calculations for different energy generation and storage technologies.
Contents:
The structure and domains of the power system types of power plants, transmission and distribution networks. Energy production measures and dimensions, seasonality and intermittancy. Energy measures and units, primary and secondary energy, sizing calculations for energy generation for centralized and decentralized solutions. Energy storage capacities, scales, sizing for short- and long-term options. Primary and secondary environmental impacts of energy production; land-use impacts and footprint-based calculations. EROI and net energy, footprint calculations and land-use impacts.
Mode of delivery:
Face-to-face teaching; the course has compulsory participation requirements.
Learning activities and teaching methods:
Lectures 36h; work assignment; continuous evaluation.
Target group:
Master’s students of environmental engineering, especially of energy and environmental engineering orientation; Master’s students in economics; Master’s students of Electrical Engineering and Information Technology. Doctoral students are also welcome to participate.
Prerequisites and co-requisites:
The course is designed to be accessible to students with the broadest background. Nevertheless, a scientific and /or technical background is an advantage.
Recommended or required reading:
Lecture slides and information on recommended reading material will be provided during the course.
Assessment methods and criteria:
The course evaluation will be based on the grades of inrermediate tasks.
Grading:
The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.
Person responsible:
Prof. Eva Pongrácz

477502A: Experiment design and analysis, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Process and Environmental Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Aki Sorsa

Opintokohteen kielet: Finnish

Leikkaavuudet:

470432A Process Control Engineering II 5.0 op

ECTS Credits:
5 ECTS /133 hours of work
Language of instruction:
Finnish
Timing:
Implementation in the 4th period on the spring term.
Learning outcomes:
After the course, the student knows different experimental design methods and their applicability for different problems. He can also design experiments for multi-variable processes and analyze the results. He can also use some basic means to visualize the results got from experimental data and choose proper tools for experiment design problems.
Contents:
Systematic design of process experiments with matrix techniques (Hadamard, Central Composite Design). Graphical and statistical analysis of experimental data. Correlation, regression and variance analysis.
Mode of delivery:
Lectures and extensive exercise work
Learning activities and teaching methods:
Lectures during one period
Target group:
Bachelor's students in process and environmental engineering
Prerequisites and co-requisites:
Course Process Dynamics is recommended beforehand.
Recommended optional programme components:
The course forms a basis to the advanced courses in the field of control engineering.
Recommended or required reading:
Reading materials. *Additional literature*: Diamond W.J.: Practical Experiment Designs. Lifetime Learning Publications. Belmont, California, 1981. 348 pp.
Assessment methods and criteria:
Homework and written/oral test. It is recommended to take the course also according to the principle of continuous evaluation.

Grading:
The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.
Read more about assessment criteria at the University of Oulu webpage.
Person responsible:
Aki Sorsa
Working life cooperation:
No

488127S: Field measurements, site investigations and geotechnical tests, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Process and Environmental Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Ali Torabi Haghighi

Opintokohteen kielet: English

Leikkaavuudet:

488118S Laboratory Exercises and Field Measurements in Environmental Engineering 10.0 op

ECTS Credits:
5 ECTS /133 hours of work
Language of instruction:
English
Timing:
The course unit is given during periods 1 and 2.
Learning outcomes:
Upon completion the student should be able to design field measurements and understand the quality of sampling and measurements in the field of environmental engineering. The student also improves skills of working in a team of fellow students to share expertise and execution responsibilities. The student understands the laboratory testing procedures and the associated parameters that help in estimating the soil mechanics and Geotechnical engineering and. The student knows how to use different methods for field measurement and sampling in water and geotechnical issues. The student can take considering the safety during the laboratory works and field measurements. After the course, the student can write detailed engineering reports.
Contents:
In the lectures: Units of measurements, error and mistake in laboratory works and field measurements, random and systematic error, precision and accuracy in laboratory work, planning field works, description of measuring site, securing results and material, sample preservation, subsoil exploration, direct & indirect methods of exploration, disturb and undisturbed samples, safety in field work, introduction on surveying, levelling, map and scale, different tests in soil mechanics laboratory.
Laboratory works in soil mechanics and geotechnical engineering: sieving test, hydrometer test, Atterberg limits test, proctor test, direct shear box test and oedometer test.
In the field: Working with GPS. Levelling and collecting data for preparing topography map. Soil sampling, surface water and groundwater sampling, Measuring velocity and discharge of river by using current meter and tracer.
Mode of delivery:
Face-to-face teaching, laboratory working
Learning activities and teaching methods:
Lectures (16 h), Fieldwork (20 h), Lab-work (9 h), Group work (88 h)

Target group:
Master students in the Water and Geo Engineering and Water and Environment study options
Prerequisites and co-requisites:
The required prerequisite is the completion of the following course prior to enrolling for the course unit: 488115A Geomechanics
Recommended or required reading:
Field measurements and Laboratory work instruction, lecture materials
Assessment methods and criteria:
Two exams (40%), Report (50%) and assignments (10%), passing the exam is requirement for passing the course
Grading:
The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.
Person responsible:
University Teacher Ali Torabi Haghighi
Working life cooperation:
No

477305S: Flow Dynamics, 5 op

Voimassaolo: 01.08.2005 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Process and Environmental Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Muurinen, Esa Ilmari

Opintokohteen kielet: Finnish

Leikkaavuudet:

470303S Flow Dynamics 3.5 op

ECTS Credits:
5 ECTS / 135 hours of work
Language of instruction:
Finnish, can be completed in English as a book examination (see Mode of Delivery).
Timing:
Implementation in autumn semester during 1st period. It is recommended to complete the course at the fourth (1st Master's) autumn semester.
Learning outcomes:
After completing the course the student is able to formulate the partial differential equations describing flow of fluids and to solve these equations in systems with simple geometry using difference, finite element and finite volume methods. The student is also able to formulate and solve the equations describing flow of granular material based on molecular dynamics. He/she is able to choose the experimental methods for validation of the calculated results and the methods to measure the most common properties describing fluid flow. After the course the student is able to model simple flow configurations using CFD and to design experimental systems and measurements for verifying computational results.
Contents:
Equations in fluid dynamics. Partial differential equations. Difference method. Graphical representation. Modelling the turbulence. Finite element method. Finite volume method. Molecular dynamics. Experimental fluid dynamics.
Mode of delivery:
In the Finnish version: Lectures and compulsory exercise done in small groups.
In the English version, compulsory simulation exercise done in small groups and a book exam, which replaces the lectures given in Finnish.
Learning activities and teaching methods:
Lectures 22h, and exercise 8 h, project work 10 h, self-study 93 h.
For foreign students written examination based on given literature and a compulsory simulation exercise.
Target group:
Master’s degree students of process and environmental engineering.
Prerequisites and co-requisites:
Courses 477301A Momentum Transfer or 477052A Fluid Mechanics, 031019P Matrix Algebra and 031022P Numerical Methods are recommended beforehand.
Recommended optional programme components:
The course is part of a stream that aims at skills needed in the phenomenon-based modelling and planning of industrial processes.
Recommended or required reading:
Anderson J.D.: Computational Fluid Dynamics, McGraw-Hill, 1995, 608 p. Hämäläinen J. & Järvinen J.: Elementtimenetelmävirtauslaskennassa, CSC – Tieteellinenlaskenta Oy, 1994, 212 p. Versteeg, H.K. &Malalasekera, W.: An Introduction to Computational Fluid Dynamics, Longman Scientific and Technical, 1995, 257 p. Pöschel, T. & Schwager, T.: Computational Granular Dynamics, 2005, 322 p. Tavoularis, S.: Measurements in Fluid Mechanics, 2005, 354 p.
Additional literature: Shaw, C.T.: Using Computational Fluid Dynamics, Prentice Hall, 1992, 251 p.; Nakayama, Y. & Boucher, R.F.: Introduction to Fluid Mechanics, Arnold, 1999, 308 p.: Haataja J., Käpyaho, J. &Rahola, J.: Numeerisetmenetelmät. CSC – Tieteellinenlaskenta Oy, 1993, 236 p; Rathakrishnan, E.: Instrumentation, Measurements, and Experiments in Fluids, 2007, 492 p.
Assessment methods and criteria:
Examination or a learning diary, and simulation exercise.
Grading:
The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail. Read more about the course assessment and grading systems of the University of Oulu at www.oulu.fi/english/studying/assessment
Person responsible:
Docent Dr Esa Muurinen
Working life cooperation:
No

477052A: Fluid Mechanics, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Process and Environmental Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Ainassaari, Kaisu Maritta

Opintokohteen kielet: Finnish

Leikkaavuudet:

477301A Momentum Transfer 3.0 op

ECTS Credits:
5 ECTS / 133 hours of work.
Language of instruction:
Finnish, can be completed in English as a book examination.
Timing:
Implementation in spring semester during 3 rd period. It is recommended to complete the course at the second (Bachelolor's) spring semester.
Learning outcomes:
After the course the student is able to determine the viscosity of pure substances and mixtures and to estimate the effect of temperature and pressure on viscosity. The student is able to recognise the interactions between a solid body and flowing fluid and to distinguish the forces, their directions and to calculate their magnitudes. The student is able to formulate momentum balance equations and to solve these in order to calculate velocity distribution, flow rate and pressure drop. The student is able to distinguish laminar and turbulent flow regimes from others and is able to use the correct equations according to flow regime. After the course the student is able to design pipelines and other simple flow mechanical process equipment.
Contents:
Viscosity. Mechanism of momentum transfer. Creating and solving differential momentum balances. Friction factor. Flow in pipes and open-channels.
Mode of delivery:
Face-to-face teaching in Finnish. Book examination in English.
Learning activities and teaching methods:
Lectures 45 h, homework 15 h and self-study 73 h. For foreign students written examination based on given literature.
Target group:
Bachelor's degree students of process and environmental engineering.
Prerequisites and co-requisites:
Knowledge of solving differential equations.
Recommended optional programme components:
The course is part of a stream that aims at skills needed in the phenomenon-based modelling and planning of industrial processes.
Recommended or required reading:
Munson, B.R., Okiishi, T.H., Huebsch W.W. & Rothmayer A.P. Fluid Mechanics, 7. painos, Wiley 2013. ISBN 978-1-118-318676
or
Gerhart, Gerhart, Hochstein 2017. Munson's Fluid Mechanics. ISBN 978-1-119-24898-9.
Assessment methods and criteria:
This course utilizes continuous assessment. During the course there are 3 intermediate exams in Finnish. The course can also be completed by final examination
Read more about the course assessment and grading systems of the University of Oulu at www.oulu.fi/english/studying/assessment.
Grading:
The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.
Person responsible:
University teacher Kaisu Ainassaari
Working life cooperation:
No

488504S: Fundamentals of nuclear energy, 5 op

Voimassaolo: 01.08.2016 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Process and Environmental Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Antonio Calo

Opintokohteen kielet: English

ECTS Credits:
5 cr/135 hours of work
Language of instruction:
English
Timing:
Autumn, period 1
Learning outcomes:
Upon completion of the course, students can define the basic elements of nuclear power production and technology. They are thus able to describe the physical processes as well as different components of a nuclear power plants and reactors. Students can also describe different elements of nuclear power technology deployment such as regulatory, safety, environmental, sustainability and health related issues.
Contents:
The first part of the course focusses primarily on the introduction of basic concepts of nuclear power production science and technology. The second part capitalizes on the information provided in the first part of the course, allowing students to fully appreciate inputs provided by guest lecturers from nuclear energy related companies, agencies and research institutes. Furthermore, during the second part of the course, students will have the possibility to test IAEA desktop simulators, providing insight and understanding of the designs as well as a better appreciation of the operational characteristics of the different reactor types.
Topics discussed during the course include: basics of nuclear physics, nuclear fission and fusion; introduction to nuclear power technology and components of a nuclear power plant; history of nuclear power production; nuclear fuel cycle, uranium mining, extraction and enrichment; fuel temporary and permanent disposal; introduction to nuclear power plant design, safety and auxiliary system design; principles of nuclear safety and strategy of accidents prevention and management; principles of health physics, monitoring safety and prevention; introduction to nuclear power safety and safety culture; nuclear energy and international law.
Mode of delivery:
Face-to-face teaching; visiting lectures. The course has compulsory participation requirements.
Learning activities and teaching methods:
Lectures 36h;work assignment; written final exam.
Target group:
Master’s students of environmental engineering, especially of energy and environmental engineering orientation; Master’s students in economics; Master’s students of Electrical Engineering and Information Technology. Doctoral students are also welcome to participate.
Prerequisites and co-requisites:
The course is designed to be accessible to students with the broadest background. Nevertheless, a scientific and /or technical background is an advantage.
Recommended or required reading:
Lecture slides and information on recommended reading material will be provided during the course.
Assessment methods and criteria:
Written final exam.
Grading:
The course evaluation will be based on the final exam.
The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.
Person responsible:
Dr. Antonio Caló
Other information:
The course will include a number of guest lecturers' contributions. When needed, lectures will happen through video conference. There might be the possibility for doctoral students located somewhere other than Oulu to attend the course via video conference as well. Such eventuality will have to be discussed and pre-arranged with the course organizers.

488140S: Groundwater modelling and management, 5 op

Voimassaolo: 28.11.2016 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Process and Environmental Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Pertti Ala-Aho

Opintokohteen kielet: English

ECTS Credits:
5 ECTS credits/133 hours of work
Language of instruction:
English
Timing:
The course is given every second spring semester (2021, 2023, 2025, etc) during period 4.

Learning outcomes:
Upon completing the course, the student is able to analyze and model groundwater systems and considering various aspects of groundwater management. The student is familiar with basic groundwater modelling concepts and tools, and understands uncertainties in numerical modeling. From different groundwater case studies, students will gain knowledge on ecological, social and economic aspects of groundwater management.
Contents:
Grid-based numerical modelling, solute transport, model uncertainties, groundwater management

Mode of delivery:
Contact teaching in lectures and practical modeling sessions. Independent work on return assignment and seminar project. Option for online course participation if unable to attend in person due to compelling reasons.
Learning activities and teaching methods:
Lectures (12 h), modelling work (48 h) and self-study and report (75 h).

Target group:
Master students in the water engineering orientation of the Hydrology and Water management program
Prerequisites and co-requisites:
The required prerequisite is the completion of the following course prior to enrolling for the course unit: 488134S Hydrogeology and groundwater engineering.
Recommended or required reading:
Fundamentals of Groundwater (Schwartz and Zhang 2002 ISBN: 978-0-471-13785-6), lecture material
Assessment methods and criteria:
Modelling assignments, and project work with report and presentation.

Grading:
The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.
Person responsible:
Postdoctoral Researcher Pertti Ala-aho
Working life cooperation:
Students get experience on modeling software used in the consulting industry, and familiarize themselves to complex real-life groundwater management cases.

488134S: Hydrogeology and groundwater engineering, 5 op

Voimassaolo: 28.11.2016 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Process and Environmental Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Pekka Rossi

Opintokohteen kielet: English

ECTS Credits:

5 ECTS credits/133 hours of work
Language of instruction:
English
Timing:
The course unit is held in the spring semester, during period 3
Learning outcomes:
Upon completion of the course, the student will have knowledge on groundwater systems and the basic hydrogeological and engineering concepts involved. This includes analysis of flow in porous media, hydraulics of groundwater systems, groundwater quality and groundwater use. After the course students are able to estimate key factors influencing on groundwater recharge, flow and discharge and to use general methods to calculate groundwater flow.
Contents:
2D and 3D groundwater flow, conceptual models, unsaturated layer flow, water storage and retention, heterogeneity and isotropy, aquifer types, pumping tests, geophysical methods, groundwater quality and resources in Finland.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
lectures (18 h), calculus lectures (12 h), homework, exercises and self-study (103 h).

Target group:
Master students in the water engineering orientation of the Environmental Engineering program and in master program of civil engineering.
Prerequisites and co-requisites:
The required prerequisite is the completion of the following course prior to enrolling for the course unit: 488102A Hydrological Processes.
Recommended or required reading:
Lecture handouts
Fundamentals of Ground Water (F.W. Schwartz, H Zhang, 2003, ISBN 0-471-13785-5) - main book, Physical and Chemical Hydrogeology (Domenico PA, Schwartz FW, 2nd edition, 1998, ISBN 0-471- 59762-7) – second option. Maanalaiset vedet - pohjavesigeologi-an perusteet (Korkka-Niemi K, Salonen V-P, 1996, ISBN 951-29-0825-5). Pohjavesi ja pohjaveden ympäristö (Mälkki E, 1999, ISBN 951-26-4515-7).

Assessment methods and criteria:
exam and/or lecture exams.
Grading:
The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.
Person responsible:
Postdoctoral Researcher Pekka Rossi
Working life cooperation:
Students familiarize themselves to a real groundwater aquifer cases discussed in lectures and in the course exercise.

488102A: Hydrological Processes, 5 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Process and Environmental Engineering

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay488102A	Hydrological Processes (OPEN UNI)	5.0 op
480207A	Hydraulics and Hydrology	5.0 op

ECTS Credits:
5 ECTS credits / 133 hours of work

Language of instruction:
Finnish, but also option to complete the course in English.
Timing:

The course is held in the autumn semester during the period 1. It is recommended to complete the course at the 1st autumn semester of the international master program of environmental engineering.

Learning outcomes:
After the course, the student understands and can describe the main hydrological processes, water movements and hydraulics phenomenon quantitatively through mathematical methods. The student also understands and quantifies the relation between state and flow with rela-tion to snowmelt, evaporation, infiltration and groundwater flow.
Contents:
Hydrological cycle, physical properties of water, distribution of water resources, water balance, precipitation, evapotranspiration, soil and ground water, infiltration, runoff, snow hydrology, hydrometry, water quality of rivers and lakes.
Mode of delivery:
Face-to-face teaching and independent work with two assignment reports.
Learning activities and teaching methods:
Lectures 24 h, exercises 16 h and independent work 93 h. Totally 133 h.
Target group:
Students in international master programs of environmental engineering
Prerequisites and co-requisites:
The recommended prerequisite is the completion of the following course or having corresponding knowledge prior to enrolling for the course unit: 477201A Material and Energy Balances and 477052A Fluid mechanics.
Recommended optional programme components:
The course is a prerequisite for most of master level studies.

Recommended or required reading:
Physical Hydrology (Dingman SL, 2002, 2nd Edition, ISBN 978-1-57766-561-8), Fluid Mechanics and Hydraulics (Giles, Evett and Liu, 3rd Edition, ISBN 0-07-020509-4)
Assessment methods and criteria:
The assignments must be returned and passed with threshold of 50% in order to get final examination. The final grade of the course is weighted average of assignment reports (80%) and examination (20%).

Grading:
The assignments must be returned and passed with threshold of 50% in order to get final examination. The final grade of the course is weighted average of assignment reports (80%) and examination (20%).

Person responsible:
University Lecturer Anna-Kaisa Ronkanen
Working life cooperation:
Examples solev in the lectures based on real problems
Other information:
The English version of the course is organized parelle to Finnish version of the course.

488203S: Industrial Ecology, 5 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Process and Environmental Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Väisänen, Virpi Maria

Opintokohteen kielet: English

Leikkaavuudet:

ay488203S	Industrial Ecology and Recycling	5.0 op
480370S	Industrial Ecology and Recycling	5.0 op

ECTS Credits:
5 ECTS credits / 135 hours of work
Language of instruction:
English
Timing:

Implementation in autumn semester during 1 st period.
Learning outcomes:
Upon completion of the course, the student will be able to use the tools of industrial ecology and apply them to industrial activity. The student can also analyze the interaction of industrial, natural and socio-economic systems and able to judiciously suggest changes to industrial practice in order to prevent negative impacts. The student can also analyze the examples of industrial symbioses and eco-industrial parks and able to specify the criteria of success for building eco-industrial parks.
Contents:
Material and energy flows in economic systems and their environmental impacts. Physical, biological and societal framework of industrial ecology. Industrial metabolism, corporate industrial ecology, eco-efficiency, dematerialization. Tools of industrial ecology, such as life-cycle assessment, design for the environment, green chemistry and engineering. Systems-level industrial ecology, industrial symbioses, eco-industrial parks.
Mode of delivery:
Face-to-face teaching in English.
Learning activities and teaching methods:
Lectures 30 h / Group work 30 h / Self-study 75 h. The exercises are completed as guided group work.
Target group:
Master's degree students of process and environmental engineering.
Recommended or required reading:
Lecture notes; Graedel T.E & Allenby B.R.: Industrial Ecology. New Jersey: Prentice Hall, 2003.
Assessment methods and criteria:
All students complete the course in a final exam. Also the exercise will be assessed. The assessment criteria are based on the learning outcomes of the course.
Read more about the course assessment and grading systems of the University of Oulu at www.oulu.fi/english/studying/assessment.
Grading:
The course utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.
Person responsible:
University teacher Virpi Väisänen
Working life cooperation:
No

900015Y: Intermediate Finnish Course 1, 5 op

Voimassaolo: 01.08.1995 -

Opiskelumuoto: Language and Communication Studies

Laji: Course

Vastuuyksikkö: Languages and Communication

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay900015Y Intermediate Finnish Course 1 (OPEN UNI) 4.0 op

Proficiency level:
A2.1
Status:
The course is intended for the international students in every faculty at the University of Oulu.
Required proficiency level:
A1.3, Completion of the Beginners' Finnish course 2 (900053Y) or the equivalent language skills.
ECTS Credits:
5 ECTS credits
Language of instruction:
Mainly Finnish
Timing:
-
Learning outcomes:
By the end of the course the student can communicate in ordinary everyday situations when the topics are familiar or connected with everyday matters. S/he can search for and locate key informational content in different kinds of texts. The student can also identify the topic and some details of the discussion around her/him. S/he can describe activities and personal experiences both orally and in writing and s/he also knows the difference between

spoken/colloquial and written/standard language. The student knows how things can be expressed with different degrees of politeness and can apply that information in her/his own communication.
Contents:
The course is a lower intermediate course. During the course students strengthen their communication skills in ordinary everyday situations and acquire a wider vocabulary and more thorough knowledge of grammar. In addition, students practise understanding and producing Finnish talk and reading newspaper articles.

The topics and communicative situations covered in the course are: requesting different kinds of requests, expressing politeness, making appointments with friends, giving directions, doing the shopping, talking about the past and talking about his/her future plans, hobbies, transactions e.g. in the doctor's and post office.

The structures studied are: more about the imperative, the verb rections, the deverbal noun (-minen), passive present tense, part of the plural declension of nouns, the third infinitive (ma-infinitive), more about sentence types, perfect tense, more about object cases.
Mode of delivery:
Contact teaching and guided self-study.
Learning activities and teaching methods:
Lessons 2 times a week (52 h, including the tests) and guided self-study (83 h)
Target group:
International degree and post-graduate degree students, exchange students and the staff members of the University
Prerequisites and co-requisites:
Completion of the Beginners' Finnish Course 2
Recommended optional programme components:
-
Recommended or required reading:
Gehring, S. & Heinzmann, S.: **Suomen mestari 2,** (chapters 1 - 5)
Assessment methods and criteria:
Regular and active participation in the weekly lessons (twice a week), homework assignments and the tests will be taken into consideration in the assessment.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Grading scale is 1-5.
Person responsible:
Anne Koskela
Working life cooperation:
-
Other information:
Sign-up in WebOodi or Tuudo.

900016Y: Intermediate Finnish Course 2, 5 op

Voimassaolo: 01.08.1995 -

Opiskelumuoto: Language and Communication Studies

Laji: Course

Vastuuyksikkö: Languages and Communication

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Proficiency level:
A2.2
Status:
The course is intended for the international students in every faculty at the University of Oulu.
Also students of the Oulu University of Applied Sciences (OAMK) may also participate to this cross-institutional study. See courses, student quota and applying for OAMK students https://www.oulu.fi/forstudents/crossinstitutionalstudy.
Required proficiency level:
A2.1, Completion of the Intermediate Finnish course 1 (900015Y) or the equivalent language skills.
ECTS Credits:
5 ECTS credits
Language of instruction:

Finnish
Timing:
-
Learning outcomes:
By the end of the course the student can communicate in various informal situations in Finnish. The student understands the main points of messages and talk around her/him. S/he can produce simple connected text on topics which are familiar or of personal interest and describe experiences and also report heard content to others.
Contents:
The course is an upper intermediate course. During the course students learn the necessary written and oral skills to be able to cope in informal situations arising during everyday life, work and study. In the course, students practise understanding more Finnish talk and written texts, and finding information and talking about it to other people. In the classes the main stress is on oral exercises and group work.
The topics and communicative situations covered in the course are: transactions e.g. in clothes shops and on the phone, Finnish small talk, reacting in different situations, information and facts about Finnish celebrations and features of colloquial/spoken language.
The structures studied are: the perfect and pluperfect, revision of all the verb tenses, comparison of adjectives, conditional, more about the plural declension of nouns (particularly the plural partitive case), more about object and predicative cases, the passive imperfect.
Mode of delivery:
Contact teaching and guided self-study
Learning activities and teaching methods:
Lessons (52 h, including the tests) and guided self-study (83 h).
Target group:
International degree and post-graduate degree students, exchange students and the staff members of the University.
Students of the Oulu University of Applied Sciences (OAMK) students and OAMK's international and exchange students may also participate to this cross-institutional study. The quota principle is as follows: at least two OAMK students in a course and if there are more places, they are filled according to the queuing principle.
See more information https://www.oulu.fi/forstudents/crossinstitutionalstudy.
Prerequisites and co-requisites:
Completion of the Intermediate Finnish Course 1 or equivalent skills
Recommended optional programme components:
-
Recommended or required reading:
Gehring, S. & Heinzmann, S.: **Suomen mestari 2 (chapters 6 - 8).**
Assessment methods and criteria:
Regular and active participation in the weekly lessons (twice a week), homework assignments and the tests will be taken into consideration in the assessment.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Grading scale is 1-5.
Person responsible:
Anne Koskela
Working life cooperation:
-
Other information:
Sign-up in WebOodi or Tuudo.

488052A: Introduction to Bioproduct and Bioprocess engineering, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Process and Environmental Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Elisa Koivuranta, Ville-Hermanni Sotaniemi

Opintokohteen kielet: English

Leikkaavuudet:

488054A	Introduction to Bioproduct and Bioprocess engineering	5.0 op
488054A	Introduction to Bioproduct and Bioprocess engineering	5.0 op

488302A Basics of Biotechnology 5.0 op

477103A Pulp and Paper Technology 3.0 op

ECTS Credits:
5 ECTS /135 hours of work
Language of instruction:
English
Timing:
The course is held in spring semester during period 3. It is recommended to complete the course in the 3 rd (Bachelor's) year
Learning outcomes:
After completing this course, a student should be able to identify key renewable natural resources and their sustainable and economical processing via mechanical, chemical and biotechnological methods. The student is able to recognize the major properties of the bioproducts and their use in different applications.
Contents:
Renewable raw materials and their properties, value chains of biomass processing. Industrial biotechnology for food and pharmaceutical applications, materials industries and environmental applications.
Mode of delivery:
Blended teaching.
Learning activities and teaching methods:
Lectures 48 h/ self-study 85 h.
Target group:
Bachelor students in process engineering and environmental engineering.
Prerequisites and co-requisites:
488309A Biocatalysis or 488212A Fundamentals of Catalysis, or respective knowledge in biocatalysis.
Recommended or required reading:
Lecture materials and other materials that will be announced at the lectures. Supplementary material: Book series: Fapet Oy. Papermaking Science and Technology; Aittomäki E et al.: Bioprosessitekniikka. WSOY 2002. 951-26995-6.
Assessment methods and criteria:
This course utilizes continuous assessment with potential web learning.
Grading:
The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.
Person responsible:
Elisa Koivuranta, Ville Sotaniemi
Working life cooperation:
No
Other information:
The course replaces earlier courses 488302A Basics of Biotechnology 5 etcs ja 477103A Pulp and Paper Technology 3 etcs.

477323A: Mass and Heat Transfer, 5 op

Voimassaolo: 01.08.2019 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Process and Environmental Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Ainassaari, Kaisu Maritta

Opintokohteen kielet: Finnish

Leikkaavuudet:

477322A Heat and Mass Transfer 5.0 op

ECTS Credits:
5 ECTS / 133 hours of work
Language of instruction:
Finnish, can be completed in English as a book examination.
Timing:

Implementation in autumn semester during 1 st period. It is recommended to complete the course at the third (Bachelor's) autumn semester.

Learning outcomes:

After passing the course the student knows what happens when heat is transferred by conduction, convection and radiation. The student can describe energy transfer with differential energy balances connected with momentum balances; In macro scale the student is able to solve practical heat transfer problems by correlating heat transfer coefficients to dimensionless flow and material characteristics; With the help of these transfer coefficients the student is capable of estimating the size of heat transfer equipment, especially heat exchangers and select the most suitable and profitable types; and to Sketch large heat nets and to diminish the costs of the equipments. The student is able to use the pinch method which optimises the number of heat exchangers and total energy consumption. He/she is also able to apply the exergy principle to make work from thermal energy. With the aid of this principle he/she will be able to divide the costs of the used energy in right proportion based on the processing stage. He/she student is able to explain diffusion as a phenomenon and the factors affecting it. He/she is able to model mass transfer in simple systems by using the theory of Fick. The student is capable of modeling diffusion by differential mass balances. He/she recognises the special features of mass transfer in turbulent systems and the role of different transport phenomena in mass transfer equipment. He/she has rudimentary practical skills applicable to the scale-up of the equipment used for absorption.

Contents:

Mechanism of heat transfer. Creating and solving differential energy balances. Heat transfer coefficient. Macroscopic balances. Selection of a proper type of heat exchanger.Scale-up and design of a heat exchanger. Design of heat exchanger networks using pinch technology.Exergy analysis for the heat flows. Diffusion. The Fick law of diffusion. Mass transfer in simple systems. Differential mass balances. Models of mass transfer in turbulent systems. Interphase mass transfer. Absorption.

Mode of delivery:

Face-to-face teaching in Finnish. Book examination possible in English.

Learning activities and teaching methods:

Lectures 45 h, homework 15 h and self-study 73 h. For foreign students written examination based on given literature.

Target group:

Bachelor's degree students of process and environmental engineering.

Prerequisites and co-requisites:

Knowledge of solving differential equations.

Recommended optional programme components:

The course is part of a stream that aims at skills needed in the phenomenon-based modelling and planning of industrial processes.

Recommended or required reading:

Welty J.R., Rorrer G.L. & Foster D.G. Fundamentals of Momentum, Heat and Mass Transfer, International student version, 6. painos, Wiley 2015,ISBN 978-1-118-80887-0, parts 14-28.

Assessment methods and criteria:

This course utilizes continuous assessment. During the course there are 4 intermediate exams. The course can also be completed by final examination.

Grading:

The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:

University teacher Kaisu Ainassaari

Working life cooperation:

No

Other information:

Replaces the course 477322A Lämmön ja aineensiirto, 5 ects.

477221A: Material and Energy Balances, 5 op

Voimassaolo: 01.08.2019 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Process and Environmental Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Marja Mikola

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay477231A Material and Energy Balances I (OPEN UNI) 2.0 op
ay477232A Material and Energy Balances II (OPEN UNI) 3.0 op
ay477221A Material and Energy Balances (OPEN UNI) 5.0 op
477201A Material and Energy Balances 5.0 op
470220A Fundamentals of Chemical Process Engineering 5.0 op

ECTS Credits:
5 ECTS /133 hours of work
Language of instruction:
Finnish. The course can be completed in English as a book examination.

Timing:
Spring periods 3 and 4.
Learning outcomes:
The student is able to formulate material and energy balances for a process by taking into account the restrictions set by reaction stoichiometry. The student knows how the created mathematical formulation can be exploited in process consideration.
Contents:
Formulation of material and energy balances by taking into account the effects of chemical reactions. Multiunit cases are also considered.
Mode of delivery:
Lectures and group exercise
Learning activities and teaching methods:
Lectures 40h, group work 10h and self-study 80h
Target group:
Bachelor students in of Process or Environmental Engineering, minor subject students in relevant disciplines.
Prerequisites and co-requisites:
High school level chemistry, mathematics and physics.
Recommended optional programme components:
The course is part of a stream that aims at skills needed in the phenomenon-based modelling and planning of industrial processes.
Recommended or required reading:
Reklaitis, G.V.: Introduction to Material and Energy Balances. John Wiley & Sons, 1983. ISBN 0-471-041319.
Assessment methods and criteria:
During the course, there are two intermediate exams and both of them must be passed. Alternatively student can participate in final exam after the course. In addition to this, the students will be making a group exercise, which will be evaluated.
Person responsible:
Juha Ahola
Other information:
This course replaces the course 477201A Material and Energy Balances, 5 ects.

477124S: Mechanical processing of biomasses, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Process and Environmental Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Elisa Koivuranta

Opintokohteen kielet: English

Leikkaavuudet:

477105S Mechanical Processing of Biomasses 3.0 op

ECTS Credits:
5 ECTS / 133 h of work
Language of instruction:
English

Timing:
Implementation in autumn period 2.
Learning outcomes:
Upon completion of the course, a student should be able to explain the value chain of mechanical and chemimechmical processing of renewable lignocellulosic raw materials. Upon completion of the course, a student should be able to identify the unit operations of mechanical and chemi-mechanical pulping process and can explain their operational principles. The student can evaluate the raw material properties and importance of different unit processes on the quality of the end products. In addition, the student can compare fibre properties of different mechanical and chemi-mechanical pulps and wood powders and can explain their effects on the quality of the end product. Student can explain production principle of engineered wood, biocomposites and pelletizing.
Contents:
Processing of wood, mechanical fibres, wood powders: raw material properties, mechanical and chemimechanical defibering, screening, bleaching, biomass micronization and pulverization, the production of engineered wood, wood-plastic composites and pellets. End product properties.
Mode of delivery:
Blended teaching
Learning activities and teaching methods:
The implementation methods of the course vary. Lectures and exercises max. 34 h, web learning and self-study 99 h. A part of the teaching can be replaced by group work or home work.
Target group:
Students interested in bioeconomy.
Prerequisites and co-requisites:
488052A Introduction to Bioproduct and Bioprocess Engineering is recommended
Recommended or required reading:
Book series: Fapet Oy. Papermaking Science and Technology, book 5: Mechanical Pulping. Lecture materials and other materials that will be announced at the lectures.
Assessment methods and criteria:
This course utilizes continuous assessment including intermediate exam(s) with potential web learning and homework. Read more about the course assessment and grading systems of the University of Oulu at https://www.oulu.fi/forstudents/assesment-criteria
Grading:
The course utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.
Person responsible:
Elisa Koivuranta
Working life cooperation:
Visiting lecturers from the industry and/or a visit/excursion to a local manufacturing site, when feasible.

477506S: Modelling and Control of Biotechnical Processes, 5 op

Voimassaolo: 01.08.2005 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Process and Environmental Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Mika Ruusunen

Opintokohteen kielet: English

Leikkaavuudet:

480452S	Bioprocess Modelling and Control	5.0 op

ECTS Credits:
5 ECTS /135 hours of work
Language of instruction:
English
Timing:
Implementation in the 1st period (autumn term).
Learning outcomes:
After the course, students can model kinetics and dynamics of bio-technical processes (mainly fermentation) starting from the process phenomena and mass balance models. They also understands the limitations of different approaches and the modelling assumptions. They also have preliminary skills to develop models in

Matlab/Simulink environment. In addition, students understand fundamentals on monitoring and optimization of bioprocesses with respect to energy, economic, and environmental issues.
Contents:
Bioreactors: models, kinetics and transfer phenomena. Models: different modelling approaches with examples. Measurements and control aspects in fermentation processes.
Mode of delivery:
Contact lectures, individual work and home tests (one per week).
Learning activities and teaching methods:
The course is given within the period of five weeks. Laboratory exercises include computational exercises and writing the report.
Target group:
Master's students in Process and Environmental Engineering / Automation Technology
Prerequisites and co-requisites:
Course Process Dynamics (previous Process Control Engineering I) or respective recommended beforehand
Recommended or required reading:
Lecture material*s.*
Additional literature: Schügerl, B. (ed.): Bioreaction Engineering. Springer Verlag, 2000. pp. 21-43.; Sonnleitner, B.: Instrumentation of Biotechnical. In: Advances in Biochemical Engineering 66. Springer 2000; Jeongseok, L. et al.: Control of Fed-batch Fermentations. Biotechnology Advances 17 (1999) 29-4817 (1999) 29-48; Rani, K.Y. & Rao, V.S.R.: Control of Fermenters - a Review. Bioprocess Engineering 21 (1999) 77-8821 (1999) 77-88

Assessment methods and criteria:
Grade given is based on home tests and exercise report; ratio is 4/1. Final examination is also possible.
Read more about the assesment criteria at University of Oulu webpage: https://www.oulu.fi/forstudents/assesment-criteria.
Grading:
The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.
Person responsible:
Aki Sorsa

477308S: Multicomponent Mass Transfer, 5 op

Voimassaolo: 01.08.2005 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Process and Environmental Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Muurinen, Esa Ilmari

Opintokohteen kielet: Finnish

Leikkaavuudet:

470302S	Multicomponent Separation	5.0 op

ECTS Credits:
5 ECTS / 133 hours of work
Language of instruction:
Finnish, can be completed in English as a book examination
Timing:
Implementation in spring semester during 4 th period. It is recommended to complete the course at the fourth (first Master's) spring semester
Learning outcomes:
Upon completing the required course work the student is able to formulate matrix equations describing mass transfer in multicomponent systems using the theory of Maxwell-Stefan and the laws of Fick for laminar and turbulent systems. He/she is also able to define bootstrap relations to bind the general equations to the physical situation of the problem, and is capable of applying the methods to estimate diffusion and mass transfer coefficients. In addition, he/she is able to describe the theories for mass transfer through phase interface, to calculate the multicomponent phase equilibrium formed by mass transfer across fluid interphase with equations of state and activity coefficient correlations, and to explain the experimental methods to measure vapour-liquid equilibrium and the methods to estimate the validity of measured values. After completing the course the student is capable of applying models of mass transfer and phase equilibrium to model and design multicomponent processes (e.g. distillation and condensation) based on diffusion.

Contents:
Maxwell-Stefan equations. Fick's law.Estimation of diffusion coefficients.Multicomponent systems. Mass transfer coefficients. Film theory. Mass transfer models for dynamic systems. Mass transfer in turbulent flows. Simultaneous mass and heat transfer. Vapour-liquid equilibrium and experimental determination. Mass transfer models in multicomponent distillation. Condensation of vapour mixtures.
Mode of delivery:
Face-to-face teaching in Finnish (book examination in English).
Learning activities and teaching methods:
Lectures 30 h, exercises 8 h, simulation exercise 15 h and self-study 80 h.
For foreign students: a written examination based on given literature and simulation exercise.
Target group:
Master's degree students of process and environmental engineering.
Prerequisites and co-requisites:
Courses 477303A Mass Transfer or 477322A Heat and Mass Transfer, 477304A Separation Processes and 031019P
Matrix Algebra are recommended beforehand.
Recommended optional programme components:
This is one of the courses in which physical chemistry is used in the applications of process and environmental engineering. It is part of a stream that aims at skills needed in the phenomenon-based modelling and planning of industrial processes.
Recommended or required reading:
Taylor, R. & Krishna, R.: Multicomponent Mass Transfer.
Oheiskirjallisuus: Walas, S.M.: Phase Equilibria in Chemical Engineering; Henley, E.J. & Seader, J.D.: Equilibrium-stage Separation Operations in Chemical Engineering.
Assessment methods and criteria:
Examination or a learning diary and a simulation exercise. Read more about the course assessment and grading systems of the University of Oulu at https://www.oulu.fi/forstudents/assesment-criteria.
Grading:
The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.
Person responsible:
Laboratory manager Dr Esa Muurinen
Working life cooperation:
No

477306S: Non-ideal Reactors, 5 op

Voimassaolo: 01.08.2005 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Process and Environmental Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Huuhtanen, Mika Ensio

Opintokohteen kielet: English

Leikkaavuudet:

470222A	Reactor Analysis and Design II	5.0 op

ECTS Credits:
5 ECTS / 135 hours of work
Language of instruction:
English
Timing:
Implementation in the spring semester during the 3th period. It is recommended to complete the course at the fourth (1st Master's) spring semester.
Learning outcomes:
After completing the course the student can analyse the effect of non-ideal mixing conditions on the behaviour of a reactor. He/she is capable of explaining the mechanisms of heterogeneous reactions, especially with methods that are used to analyse the effect of mass and heat transfer on the observed kinetics of heterogeneous reactions. The student has rudimentary skills to conduct demanding reactor analysis and to design heterogeneous reactors ((i.e. multicomponent and multiphase reactors).
Contents:

Mixing models of a flowing material. Residence time distribution theory. Heterogeneous catalysis and biochemical reactions: mechanisms, mass and heat transfer, and reactor design. Gas-liquid reactions: mechanisms, mass transfer, and reactor design. Design heuristics. Microreactors.

Mode of delivery:
Lectures including exercises and computer simulations (CFD), face-to-face teaching.

Learning activities and teaching methods:
Lectures 30 h, exercises and simulation 14 h, homework 16 h, self-study 75 h.

Target group:
Master's degree students of Process and Environmental Engineering study programmes.

Prerequisites and co-requisites:
Courses 477201A Energy and Material Balances and 477202A Reactor Analysis are recommended beforehand.

Recommended or required reading:
Fogler, H. Scott: Elements of chemical reaction engineering. (5th edition) 2016. Prentice Hall PTR: Pearson Education International; Nauman, E.B.: Chemical Reactor Design. New York, John Wiley & Sons.1987; Additional literature: Winterbottom, J.M. & King, M.B. (Editors) Reactor Design for Chemical Engineers. Padstow 1999, T.J. International Ltd. 442 s. Gianetto, A. &Silveston, P.L.: Multiphase Chemical Reactors: Theory, Design, Scale-up. Hemisphere, Washington, D. 1986; Froment, G. & Bischoff, K.B.: Chemical Reactor Analysis and Design. New York, John Wiley & Sons. 1990; Hessel, V., Hardt, S. &Löwe, H.: Chemical Micro Process Engineering. Weinheim 2004, Wiley-VHC Verlag GmbH & Co. 674 p, Salmi, T., Mikkola, J.-P.& Wärnå, J. Chemical reaction engineering and reactor technology. Boca Raton 2011, CRC Press, 615 p.

Assessment methods and criteria:
Intermediate exams (2) or final examination.. Homework assignments affect the course grade. Read more about the course assessment and grading systems of the University of Oulu at https://www.oulu.fi/forstudents/assesment-criteria

Grading:
The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:
University Lecturer Mika Huuhtanen

Working life cooperation:
No

Other information:
By means of the residence time distribution theory, students adopt a way of thinking in modeling which is based on the concept of probability.

477625S: Power Plant Automation, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Process and Environmental Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Jenö Kovács

Opintokohteen kielet: Finnish

Leikkaavuudet:

477611S	Power Plant Automation	2.0 op
477612S	Power Plant Control	3.0 op

ECTS Credits:
5 ECTS / 135 hours of work

Language of instruction:
Finnish (available in English as a book exam: students will receive materials to study and take an final exam based on those materials)

Timing:
Period 3 (spring term)

Learning outcomes:
The student has a full understanding of the role of the power plants in energy market and the importance of different energy sources. The student will understand the structure of different power plants, the main components and can explain their behavior and operation. The role and manner of measurements will be clarified. Furthermore, the student will understand the main principles in modelling energy systems. The student will fully understand the static and dynamic behaviour of the power plants and the sub processes. The student will

understand the role of control in power plant operation and can describe the main principles and structures of control systems. The student can implement the theoretical knowledge gained in power plant automation courses into practice and has deepened his/her understanding in the subject. The student knows the principles of power plant operation in different situations (start-ups and shut-downs, load changes).

Contents:
Introduction to energy market and consumption. Description of different types of power plants and the main components and their operation. Fundamentals of industrial measurements, sensors, emissions and industrial actuators. Static and dynamic modelling of power plants. . The control principles and the main control loops. Comparison of different control solutions. 3 x 4h simulation exercises in small groups (2-4 persons) with a MetsoDNA power plant simulator.

Mode of delivery:
Face-to-face teaching

Learning activities and teaching methods:
Lectures, exercises and industrial visit. Final exam.

Target group:
M.Sc. students in process and environmental engineering

Prerequisites and co-requisites:
No

Recommended or required reading:
Lecture hand-out and Joronen,T., Kovács J. & Majanne Y. (2007) Voimalaitosautomaatio. Suomen automaatioseura Oy. 276 pp.

Assessment methods and criteria:
Exam

Grading:
Numerical grading scale 1-5 or fail

Person responsible:
Docent Jenö Kovács

Working life cooperation:
No

477203A: Process Design, 5 op

Voimassaolo: 01.08.2005 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Process and Environmental Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Ahola, Juha Lennart

Opintokohteen kielet: English

Leikkaavuudet:

480310A Fundamentals of Process Design 5.0 op

ECTS Credits:
5 ECTS /133 hours of work

Language of instruction:
English

Timing:
Period 4

Learning outcomes:
The student is able to identify the activities of process design and the know-how needed at different design stages. The student is capable of utilising process synthesis and analysis tools for creating a preliminary process concept and pointing out the techno-economic performance of the process concept based on holistic criteria.

Contents:
Acting in process design projects. Safety and environmentally conscious process design. Design tasks from conceptual process design to plant design, especially the methodology applicable for preliminary process and plant design.

Mode of delivery:
Lectures and process design exercises in groups.

Learning activities and teaching methods:

Lectures 30 h, group work 50 h and self-study 50 h.
Target group:
Bachelor students in Process and Environmental Engineering.
Prerequisites and co-requisites:
Objectives of 477202A Reactor analysis and 477304A Separation processes.
Recommended optional programme components:
-
Recommended or required reading:
Lecture handouts, Seider, W.D., Seader, J.D. and Lewin, D.R. Product and process design principles: Synthesis, analysis and evaluation. John Wiley & Sons, 2004. (Parts) ISBN 0-471-21663-1
Assessment methods and criteria:
Combination of a final exam or two midterm exams and group design exercises.
Read more about the course assessment and grading systems of the University of Oulu at www.oulu.fi/english/studying/assessment

Grading:
Scale 0-5
Person responsible:
Dr Jani Kangas
Working life cooperation:
-
Other information:
-

477524S: Process Optimization, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Process and Environmental Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Aki Sorsa

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay477524S	Process Optimization (OPEN UNI)	5.0 op
477504S	Process Optimization	4.0 op

ECTS Credits:
5 ECTS /135 hours of work
Language of instruction:
English
Timing:
Spring semester, the 3th period. Recommended for 1st year M.Sc. students.
Learning outcomes:
Student can use and apply standard unconstrained and constrained optimization methods. Student understands the basic of evolutionary optimization algorithms and can use them. Student can define and identify optimization problems. Student is able to summarize the role of optimization in process engineering.
Contents:
Basic concepts of optimization. Optimization of unconstrained and constrained functions. Linear programming. Trajectory optimization. Evolutionary algorithms in optimization. Applications in process engineering.
Mode of delivery:
Face-to-face teaching and exercises.
Learning activities and teaching methods:
The amount of guided teaching is 40 hrs. Contact teaching includes, depending on situation, lectures, group work and tutored group work. During self-study time student does independent or group work.
Target group:
M.Sc. students of process and environmental engineering and M.Sc. students interested in process optimization. Exchange and other international students.
Prerequisites and co-requisites:
No prerequisites but basic understanding on numerical methods and process modelling are useful.

Recommended optional programme components:
See prerequisites
Recommended or required reading:
Reading materials. Ray, W.H. & Szekely, J. (1973) Process Optimization with Applications in Metallurgy and Chemical Engineering. John Wiley & Sons.
Assessment methods and criteria:
This course uses continuous assessment that includes homework and classroom or home exams.
Grading:
The course unit uses a numerical grading scale 1-5. In the numerical scale zero stands for a fail.
Person responsible:
Aki Sorsa
Working life cooperation:
No

477309S: Process and Environmental Catalysis, 5 op

Voimassaolo: 01.08.2005 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Process and Environmental Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Satu Pitkäaho

Opintokohteen kielet: English

Leikkaavuudet:

470226S Catalytic Processes 5.0 op

ECTS Credits:
5 ECTS / 133 hours of work
Language of instruction:
English
Timing:
Implementation in autumn semester, during 1 st period. It is recommended to complete the course at the fourth (1 st Master's) autumn semester.
Learning outcomes:
Student recognizes the connection between catalysis and green chemistry and the role of catalysis in sustainable processes, energy production, and environmental engineering. Student is able to explain the most important industrial catalytic processes, the use of catalysts in environmental technology, and the importance of catalyst research.
Contents:
Catalyst and catalysis, sustainability. Catalysis in industry. Environmental catalysis.

Mode of delivery:
Lectures including design exercises, face-to-face teaching.
Learning activities and teaching methods:
Lectures 20 h, exercises 10 h, teamwork presentations 20 h, portfolio work 40 h and self-study 60 h.

Target group:
Master’s degree students of the Process and Environmental Engineering study programmes.
Prerequisites and co-requisites:
488212A Katalyysin perusteet or 488309A Biokatalyysi
Recommended or required reading:
-

Assessment methods and criteria:
Portfolio and written examination
Grading:
The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.
Person responsible:
Satu Pitkäaho and Esa Turpeinen
Working life cooperation:

No

477501A: Process dynamics, 5 op

Voimassaolo: 01.08.2015 -
Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Field of Process and Environmental Engineering
Arvostelu: 1 - 5, pass, fail
Opettajat: Aki Sorsa
Opintokohteen kielet: Finnish
Leikkaavuudet:

ay477501A Process Control Engineering I 5.0 op
470431A Process Control Engineering I 5.0 op

ECTS Credits:
5 ECTS /133 hours of work
Language of instruction:
Finnish/English. The main lecturing language is Finnish, but the course can also be taken in English with some special arrangements. Contact the responsible person.
Timing:
Negotiable (for the English version).
Learning outcomes:
After the course, the student understands the basic principles of dynamical behaviour of different processes, can write dynamic mass and energy balances for unit processes, and can solve these with the help of the transfer function approach. He knows also the connection between process control and process dynamics.
Contents:
Basics of process models and dynamics. Dynamic models. Lumped and distributed parameter models. Practical examples of different unit processes such as chemical reactors and heat exchangers. Modelling of large-scale processes.

Mode of delivery:
Negotiable (the course can be taken in English with some special arrangements - contact the responsible person).
Learning activities and teaching methods:
Solving exercise problems; textbook.
Target group:
Exchange and other international students (for the English version).
Prerequisites and co-requisites:
No course requirements.
Recommended optional programme components:
The course forms a basis to the advanced courses in the field of control engineering.
Recommended or required reading:
Lecture handout and other material distributed at the lecture.
Recommended for supplementary literature: Luyben, W.L.: Process Modeling, Simulation and Control for Chemical Engineers. McGraw-Hill cop., New York 1990, 725 p.
Assessment methods and criteria:
Homework and written/oral test

Grading:
The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail. Read more about assessment criteria at the University of Oulu webpage.
Person responsible:
Aki Sorsa
Working life cooperation:
No

488209S: Renewable Energy, 5 op

Voimassaolo: 01.08.2019 -
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Field of Process and Environmental Engineering
Arvostelu: 1 - 5, pass, fail
Opettajat: Huuhtanen, Mika Ensio
Opintokohteen kielet: English

ECTS Credits:
5 ECTS credits / 135 hours of work.
Language of instruction:
English
Timing:
Period 1
Learning outcomes:
The student is able to define different methods and techniques on renewable energy production field. The student can describe the energy production from renewable sources and is able to compare the environmental impacts of different ways of producing energy. He/she is able to identify main specific characters, challenges and driving forces in the field.
Contents:
Renewable energy production methods and technologies. Water and wind power, solar energy, biofuels, biomass conversion, side-streams utilization, power-to-X technologies, emissions and environmental aspects.
Mode of delivery:
Contact lectures
Learning activities and teaching methods:
Lectures 40h, self-study 95h
Target group:
Master's degree students of Process and Environmental Engineering study programmes.
Prerequisites and co-requisites:
Course 488208A Energian tuotannon ja käytön perusteet is recommended.
Recommended optional programme components:
The course is pre-requirement for 488206S Sustainable Energy Project course.

Recommended or required reading:
Materials delivered via the Moodle environment.

Assessment methods and criteria:
Written final exam.
Read more about the course assessment and grading systems of the University of Oulu at https://www.oulu.fi/forstudents/assesment-criteria

Grading:
The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.
Person responsible:
University lecturer Mika Huuhtanen
Working life cooperation:
No
Other information:
This course has replaced the course 488202S Production and Use of Energy.

477312S: Science and Professional Ethics, 5 op

Voimassaolo: 01.08.2019 -
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Field of Process and Environmental Engineering
Arvostelu: 1 - 5, pass, fail
Opettajat: Keiski, Riitta Liisa
Opintokohteen kielet: English

Leikkaavuudet:

477321S Research Ethics 3.0 op

ECTS Credits:
5 ECTS credits
Language of instruction:
English
Timing:
The course is held in Spring semester. The course is recommended to be taken during the 2nd of the M.Sc. studies. Post-graduate students are also welcomed to the course and they can, by passing this course compensate the UniOGS course on Science ethics (2 ECTS credits).
Learning outcomes:
After the course, students are familiar with the ethical codes of research, and are able to recognise and analyse ethical problems related to different fields and stages during their professional and researcher career, and in research.
Contents:
Basis for the research and professional ethics. Professional ethics. Ethical problems characteristic to the fields of technology and natural sciences. Ethical challenges and problem solving in different stages of researcher education and activities related to research. Research integrity, i.e. good scientific practice and procedures for handling misconduct and fraud in science. Ethical problems regarding the relation between scientific community and wider society.
Mode of delivery:
General ethics lectures (20 h), guest lectures (2-6 h), learning portfolio, group work and a seminar.
Learning activities and teaching methods:
Regular attendance of lectures, participation in group work and oral presentation.
Grading:
1 – 5
Person responsible:
Riitta Keiski (e-mail: firstname.lastname (at) oulu.fi)
Other information:
This Course replaces course 477321S Research Ethics (3 ECTS).

477304A: Separation Processes, 5 op

Voimassaolo: 01.08.2005 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Process and Environmental Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Muurinen, Esa Ilmari

Opintokohteen kielet: Finnish

Leikkaavuudet:

470323A Separation Processes 5.0 op

ECTS Credits:
5 ECTS / 133 hours of work
Language of instruction:
Finnish, can be completed in English as a book examination.
Timing:
Implementation in autumn semester during the 2nd period. It is recommended to complete the course on the third (Bachelor's) autumn semester.
Learning outcomes:
After the course the student is able to define the position of separation processes based on mass transfer in process and environmental engineering. He/she is capable of solving phase equilibrium problems in multistage separations for binary mixtures. The student is able to explain the phenomena behind the following separation processes: distillation, absorption, stripping, liquid-liquid extraction, supercritical extraction, crystallisation, adsorption, chromatography separation, membrane separations, and reactive separations. He/she recognises the equipment used for these processes and is able to compare the methods to each other with heuristic rules.
Contents:

Separation processes based on mass transfer in process and environmental engineering. Phase equilibrium problems in multistage separations for binary mixtures. Phenomena behind the following separation processes: distillation, absorption, stripping, liquid-liquid extraction, supercritical extraction, crystallisation, adsorption, chromatography separation, membrane separations, and reactive separations. Equipment used for these processes and is able to compare the methods to each other with heuristic rules, etc.

Mode of delivery:
Face-to-face teaching in Finnish. Book examination possible in English.

Learning activities and teaching methods:
Lectures 40 h, exercises 20 h, homework 15 h and self-study 58 h. For foreign students written examination based on given literature and homework.

Target group:
Bachelor's degree students of process and environmental engineering.

Prerequisites and co-requisites:
Courses 477301A Momentum Transfer, 477302A Heat Transfer and 477303A Mass Transfer;
or 477052A Fluid Mechanics and 477312A Heat and Mass Transfer are recommended beforehand.

Recommended optional programme components:
This is one of the courses in which physical chemistry is used in the applications of process and environmental engineering. It is part of a stream that aims at skills needed in the phenomenon-based modelling and planning of industrial processes.

Recommended or required reading:
Seader, J.D., Henley, E.J. & Roper, D.K.: Separation Processes Principles. Wiley 2011, 821 p.; Noble, R.D. & Terry, P.A.: Principles of Chemical Separations with Environmental Applications. Cambridge 2004, Cambridge University Press.321 p.

Assessment methods and criteria:
Examination. The course can be completed with three intermediate exams or one final exam. Homework assignments affect the course grade.
Read more about the course assessment and grading systems of the University of Oulu at https://www.oulu.fi/forstudents/assesment-criteria.

Grading:
The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:
Laboratory manager Dr Esa Muurinen.

Working life cooperation:
No

477523S: Simulation, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Process and Environmental Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Markku Ohenoja

Opintokohteen kielet: Finnish

Leikkaavuudet:

477503S	Simulation	3.0 op

ECTS Credits:
5 ECTS / 135 hours of work

Language of instruction:
Finnish and English

Timing:
Implementation in the 2nd autumn period. Recommended for fourth (1st M.Sc.) year students.

Learning outcomes:
Upon completion the student is capable of explaining the concepts and operation principles for both simulators of continuous processes and event-based simulation. The student has skills to construct simulation models in Matlab-Simulink environment and to explain the operation of these models. The student recognizes the key problems of the simulation and is able to choose suitable modeling solutions in process modeling and control. Moreover, the student is able to use key concepts of interactive and distributed simulation. After the course the student is able to search other relevant simulation languages and programming tools.

Contents:
Modelling, modular and equation based simulation, dynamic simulation, intelligent methods in simulation, simulation in automation, event handling in continuous simulation, simulation of production processes, distributed simulation, integration with other systems, simulation languages and programming tools.

Mode of delivery:
Face-to-face teaching and exercises.
Learning activities and teaching methods:
The amount of guided teaching is 32 hours. Contact teaching includes, depending on situation, lectures, exercises and seminars. Totally 58 h are allocated for self-study, which consists of three parts: (1) a case study covering several topics applied in a chosen problem, (2) a seminar work concentrating on a single topic, and (3) the final report.
Target group:
M.Sc. students in process and environmental engineering, machine engineering, computer engineering and industrial engineering and management.
Prerequisites and co-requisites:
No prerequisites, but Matlab programming skills and understanding of process dynamics are a benefit.
Recommended optional programme components:
Courses 488051A AutoCAD and Matlab in Process and Environmental Engineering and 477501A Process Dynamics support the implementation of the case study.
Recommended or required reading:
Lecture notes and exercise materials. Material is in Finnish and in English.
Assessment methods and criteria:
The assessment of the course is based on learning diaries, exercises, seminar presentation and the final report.
Grading:
The course unit uses a numerical grading scale 1-5. In the numerical scale zero stands for a fail.
Person responsible:
D.Sc. (Tech.) Markku Ohenoja
Working life cooperation:
No

488501S: Smart Grid I: Integrating renewable energy sources, 5 op

Voimassaolo: 01.08.2016 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Process and Environmental Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Eva Pongracz

Opintokohteen kielet: English

ECTS Credits:
5 cr/150 hours of work
Language of instruction:
English
Timing:
Period 2
Learning outcomes:
The student is able to explain the concept of smart grids, the evolution of smart grids from electricity power grids, the information technology requirements as well as the economic, environmental and social implications of smart grids. The student can explain the basic functioning of energy markets in Finland and the Nordic countries as well as the basics of electricity and carbon pricing. The student is also able to find real time data on variable energy sources (VRES) and able to apply the residual curve equation. The student can also explain the costs of large scale VRES integration and how they can be mitigated. The student can also explain demand site flexibility and the need for flexibility services emerging in the smart grid system. The student will know the expectations from smart grids and is able to outline the future perspectives of smart grid-based energy systems. The student is able to draft a scenario for the decarbonization of the energy system by 2050, and assess its economic, environmental and geopolitical implications, as well as the technological and infrastructural gaps.
Contents:

Multidisciplinary course, offered at the Faculty of Technology (Water, Energy and Environmental Engineering research group – WE3), in cooperation with Oulu Business School (OBS, Department of Economics) and the Faculty of Information Technology and Electrical Engineering (Centre of Wireless Communication - CWC).
After an introductory presentation on the requirements, the background is set on the energy and environmental crisis, the co-evolution of energy and information systems and outlining the transition to a smarter system. Further, lectures on smart grids will be provided from an electrical engineering and information technology view on the evolution of electricity power grids, power generation transmission and distribution; distributed generation and futures of smart grids. From an environmental engineering point of view, lectures will be delivered on energy systems fundamentals, climate goals and decarbonization, as well as on the sustainability of smart grids will in particular the environmental and social impacts of smart grids. From economics points of view, lectures will be given on the liberalization and deregulation of the electricity market, electricity pricing, transmission and distribution as natural monopolies, smart grids and new market mechanisms, and the economic impacts of large-scale integration of renewable energy sources. Participation on lectures is not compulsory, but students are to answer to problem questions.
As an exercise, students will be given a group work assignment that they are to work with throughout the duration of the course with the help of mentors. The subjects of the exercise is achieving climate goals and the future of energy systems.

Mode of delivery:
Implemented as face-to-face teaching and student seminar. The course largely relies on participatory learning, therefore, there are compulsory participation requirements.

Learning activities and teaching methods:
Lectures 32 h / student presentations 8 h, Guided group work: 8 h, individual homework 50 h/group work 37 h.

Target group:
Master's students of environmental engineering, especially of energy and environmental engineering orientation; Master's students in economics; Master's students of Electrical Engineering and Information Technology.

Prerequisites and co-requisites:
For Environmental Engineering students, admission to the Master's programme, for which minimally a former bachelor's degree is required. For other students the Bachelor level studies. A minimum of 10 ECTS worth of prior energy studies, bachelor level studies are acceptable. For example at Oulu: 488202S Production and use of energy, 488504S Fundamentals of nuclear energy.

Recommended or required reading:
Will be provided during the course by the lecturers.
Chen-Ching Liu, Stephern McArthur and Seung-Jae Lee (eds.)(2016) Smart Grids handbook, 3 volume set, and Stephen F. Bush (2014): Smart Grid: Communication-Enabled Intelligence for the Electric Power Grid. http://onlinelibrary.wiley.com/book/10.1002/9781118820216.

Assessment methods and criteria:
Answering problem questions and group exercise. Compulsory requirements are completing learning portfolio, answering of at least 75% of problem questions, participation in 50% of intermediate presentations and compulsory participation in the final presentation.

Grading:
The course evaluation will be based on an on-line learning portfolio and performance in the exercise participation and exercise report. The course unit utilizes a numerical grading scale 1-5. In the numerical scale, zero stands for a fail.

Person responsible:
Docent Eva Pongrácz (EEE) and Prof. Maria Kopsakangas-Savolainen (OBS). Other lecturers: EEE: Dr. Antonio Caló, Dr. Jean-Nicolas Louis; OBS: Prof. Rauli Svento, M.Sc. Mari Heikkinen, M.Sc. Hannu Huuki, M.Sc. Santtu Karhinen, M.Sc. Enni Ruokamo; CWC: Dr. Sc. Jussi Haapola.

Other information:
The number of students is limited. This course is a 5 credit course for engineering students, but economics students gain overall 6 credits by doing a mandatory extra assignment which corresponds to 1 credit.

488502S: Smart Grid II: Smart buildings/smart customers in the smart grid, 5 op

Voimassaolo: 28.11.2016 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Process and Environmental Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Eva Pongracz

Opintokohteen kielet: English

ECTS Credits:
5 cr/137 hours of work
Language of instruction:
English
Timing:
Period 3
Learning outcomes:
The student is able to explain the concept of smart houses, and is able to demonstrate the optimization of smart house functions for energy efficiency, decarbonization and cost savings. Further, the student is familiar with the concepts and the technologies of smart house automation as well as other technologies used in smart houses such as smart appliances, smart metering and energy storage. The student will also understand the new role of consumers in the smart grid environment, their changing roles as well as current and future models of energy services. The student will also understand the risks of smart houses in terms of cyber security, data privacy and management. In addition, the student is able to outline the future perspectives of smart houses and smart consumers as part of the smart city framework and aiming toward eco-cities of the future.
Contents:
Multidisciplinary course, offered in cooperation of the Faculty of Technology (Energy and Environmental Engineering Research Unit - EEE), Oulu Business School (OBS, Department of Economics) and the Faculty of Information Technology and Electrical Engineering (Centre of Wireless Communication - CWC). After an introductory presentation on the course requirements, the basics are set in terms of defining smart houses as part of smart grids. Further the complementary roles of smart houses for energy efficiency, costs saving and decarbonization is explained. The key technologies of smart houses will be explained and demonstrated, including company presentations on existing commercial technologies and service models. In addition, the new role of consumers as prosumers and service users will be explained and demonstrated. There will be no exam, however, the students are to answer to problem questions related to the lectures and complete the exercises. There will be 4 exercises, concentrating on the 4 key themes of the course: smart house functions, smart house technologies, smart consumers, and energy services. Part of the exercises will be done as individual work that will be reported and some will be performed as group work. There will also be in-class guided exercises.
Mode of delivery:
Implemented as face-to-face teaching, visiting lectures and student presentations. The course largely relies on participatory learning, therefore, there are compulsory participation requirements.
Learning activities and teaching methods:
Lectures 28 h, student presentations 4 h, guided exercise work 24 h, individual work 45 h, group work 34 h.
Target group:
Master's students of environmental engineering, especially of energy systems orientation; Master's students in economics; Master's students of Electrical Engineering and Information Technology. Doctoral students are also welcome to participate.
Prerequisites and co-requisites:
Course 488501S Smart Grid I.
Recommended or required reading:
Will be provided during the course by the lecturers.
Chen-Ching Liu, Stephern McArthur and Seung-Jae Lee (eds.)(2016) Smart Grids handbook, 3 volume set, and Stephen F. Bush (2014): Smart Grid: Communication-Enabled Intelligence for the Electric Power Grid. http://onlinelibrary.wiley.com/book/10.1002/9781118820216.
Assessment methods and criteria:
Answering problem questions, individual and group exercise. Compulsory requirements are completing learning portfolio, answering of at least 75% of problem questions, compulsory participation in the in-course exercises and participation in the student presentation.
Grading:
The course evaluation will be based on an on-line learning portfolio, exercise performance and exercise report. The course unit utilizes a numerical grading scale 1-5. In the numerical scale, zero stands for a fail.
Person responsible:
Dr. Jean-Nicolas Louis
Other lecturers: Prof. Eva Pongrácz, Dr. Antonio Caló and Adeleye Adetunji.
Other information:
The number of students is limited. This course is a 5 credit course for engineering students, but economics students gain overall 6 credits by doing a mandatory extra assignment which corresponds to 1 credit.

488503S: Smart Grid III: Smart energy networks, 5 op

Voimassaolo: 28.11.2016 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Process and Environmental Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Eva Pongracz

Opintokohteen kielet: English

ECTS Credits:
5 cr/150 hours of work
Language of instruction:
English
Timing:
During period 4 in spring semester
Learning outcomes:
The student is able to explain the concept of energy transition, and is able to outline the structure and functioning of smart energy networks. Further, the student is familiar with the concepts of multiple energy networks, integrating multiple energy networks and networks flow analysis. The student will also understand the concept of swarms of distributed energy generation and the need for storage to ensure network stability. The student will also able to outline the key energy storage methods and will be able to recommend them for distributed vs. centralized storage of both heat and electricity, for long term as well as short term. The student will also be able to use design tools for the planning and evaluation of future energy systems. The student will also be able to assess the dimensions of sustainability of smart energy networks.
Contents:
Multidisciplinary course, offered in cooperation of the Faculty of Technology (Energy and Environmental Engineering Research Unit - EEE), Oulu Business School (OBS, Department of Economics) and the Faculty of Information Technology and Electrical Engineering (Centre of Wireless Communication - CWC). After an introductory presentation on the course requirements, the basics are set in terms of defining energy transition to a carbon neutral energy future. Further the integration of multiple energy networks will be explained, as well as communication within multiple energy networks. The issue of swarms of distributed generation will be explained, as well as the economics of a system relying largely on renewables. The key storage technologies will be explained, demonstrating their use for heat or electricity storage, their effectiveness on small or large scale, as well as their purpose and economics of short and long term storage. Communication within the smart grid as well the economics of distributed generation in a future carbon neutral energy system will be explained. Finally, the sustainability assessment of smart energy network performance will be explained. There will be no exam, however, the students will need to answer to problem questions related to the lectures and complete exercises. There will be 3 exercises, concentrating on (1) evaluation of storage technologies, (2) simulation of future smart energy networks and (3) sustainability assessment. The simulation work will be done as group work using the EnergyPlan freeware, for which in-class guidance will be provided. The results of the simulation will have to be presented. The rest will be done as individual work.
Mode of delivery:
Implemented as face-to-face teaching, visiting lectures and student presentations. The course largely relies on participatory learning, therefore, there are compulsory participation requirements.
Learning activities and teaching methods:
Lectures 28 h, student presentations 4 h, guided exercise work 24 h, individual work 50 h, group work 38 h.
Target group:
Master’s students of environmental engineering, especially of energy and environmental engineering orientation; Master’s students in economics; Master’s students of Electrical Engineering and Information Technology. Doctoral students are also welcome to participate.
Prerequisites and co-requisites:
Completing Smart grids 1 is a prerequisite, completing Smart grids 2 prior to this course is also recommended.
Recommended or required reading:
Will be provided during the course by the lecturers.
Chen-Ching Liu, Stephern McArthur and Seung-Jae Lee (eds.)(2016) Smart Grids handbook, 3 volume set, and Stephen F. Bush (2014): Smart Grid: Communication-Enabled Intelligence for the Electric Power Grid. http://onlinelibrary.wiley.com/book/10.1002/9781118820216.
Assessment methods and criteria:
Answering problem questions, individual and group exercise. Compulsory requirements are completing learning portfolio, answering of at least 75% of problem questions, compulsory participation in the in-course exercises and participation in the student presentation.
Grading:
The course evaluation will be based on an on-line learning portfolio, exercise performance and exercise report. The course unit utilizes a numerical grading scale 1-5. In the numerical scale, zero stands for a fail.
Person responsible:

Prof. Eva Pongrácz (EEE) and Prof. Maria Kopsakangas-Savolainen (OBS). Other lecturers: EEE: Dr. Antonio Caló, Dr. Jean-Nicolas Louis; OBS: Enni Ruokamo; CWC: Dr. Jussi Haapola, MSc. Florian Kühlenz
Other information:
The number of students is limited. This course is a 5 credit course for engineering students, but economics students gain overall 6 credits by doing a mandatory extra assignment which corresponds to 1 credit.

900027Y: Special Course in Finnish: Writing Skills, 3 op

Voimassaolo: 01.08.1995 -

Opiskelumuoto: Language and Communication Studies

Laji: Course

Vastuuyksikkö: Languages and Communication

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Proficiency level:
B1/B2, according to the Common European Framework.
Status:
Course is intended for the international students in every faculty at the University of Oulu.
Students of the Oulu University of Applied Sciences (OAMK) students and OAMK's international and exchange students may also participate to this cross-institutional study. The quota principle is as follows: at least two OAMK students in a course and if there are more places, they are filled according to the queuing principle.See more information https://www.oulu.fi/forstudents/crossinstitutionalstudy.
Required proficiency level:
A2.2 Completion of the Finnish for Advanced Students (900020Y) or the equivalent language skills.
ECTS Credits:
3 ECTS credits
Language of instruction:
Finnish
Timing:
-
Learning outcomes:
By the end of the course the student can write coherent and detailed descriptions and summaries about various matters. S/he is able to summarize text and justify his/her own statements of opinions. In addition, the student knows the steps of the writing process and understands the significance of a text's function and target audience. S/he can also differentiate between formal and informal writing styles.
Contents:
During the course students develop their writing skills in Finnish and are guided in the drafting of different text types and documents needed in studies and work. In the course students learn how to write informal and formal letters, an argument-essay, a summary, a job application and a report.
Mode of delivery:
One contact lesson at the beginning of the course and guided independent studying using online
Learning activities and teaching methods:
The course will be held online using a Moodle environment.
Target group:
Course is intended for the international students in every faculty at the University of Oulu.
Students of the Oulu University of Applied Sciences (OAMK) students and OAMK's international and exchange students may also participate to this cross-institutional study. The quota principle is as follows: at least two OAMK students in a course and if there are more places, they are filled according to the queuing principle.See more information https://www.oulu.fi/forstudents/crossinstitutionalstudy.
Prerequisites and co-requisites:
Completion of the Intermediate Finnish Course 2
Recommended optional programme components:
-
Recommended or required reading:
Web based material in Moodle.
Assessment methods and criteria:
To pass the course, the student must complete all the required writing assignments.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Grading is on a pass/fail basis.

Person responsible:
Anne Koskela
Working life cooperation:
-
Other information:
Sign-up in WebOodi or in Tuudo. Staff members in staff training portal.

900017Y: Survival Finnish, 2 op

Voimassaolo: 01.08.1995 -

Opiskelumuoto: Language and Communication Studies

Laji: Course

Vastuuyksikkö: Languages and Communication

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay900017Y Survival Finnish Course (OPEN UNI) 2.0 op

Proficiency level:
A1.1
Status:
The course is intended for the international students in every faculty at the University of Oulu.
Required proficiency level:
No previous Finnish studies.
ECTS Credits:
2 ECTS cr
Language of instruction:
Finnish and English.
Timing:
-
Learning outcomes:
By the end of the course the student can understand and use some very common everyday expressions and phrases, and s/he can locate informational content in simple texts and messages. The student also knows the basic characteristics of Finnish language and Finnish communication styles.
Contents:
This is an introductory course which aims to help students to cope with the most common everyday situations in Finnish. During the course, students learn some useful everyday phrases, some general features of the vocabulary and grammar, and the main principles of pronunciation.

The topics and communicative situations covered in the course are: general information about the Finnish language, some politeness phrases (how to greet people, thank and apologize), introducing oneself, giving and asking for basic personal information, numbers, some time expressions (how to tell and ask the time, days of the week, time of day), food, drink and asking about prices.

The structures studied are: personal pronouns and their possessive forms, forming affirmative, negative and interrogative sentences, the conjugation of some verbs, the basics of the partitive singular and some local cases for answering the ‘where'-question.
Mode of delivery:
Contact teaching, on-line learning and independent work. There will be organized also one on-line group in each semester.
Learning activities and teaching methods:
Lessons 2 times a week (26 h, including the final exam) and guided self study (24 h).
Target group:
International degree and post-graduate degree students, exchange students and the staff members of the University.
Prerequisites and co-requisites:
-
Recommended optional programme components:
-
Recommended or required reading:

Will be provided during the course.
Assessment methods and criteria:
Regular and active participation in the weekly lessons (twice a week), homework assignments and written exam at the end of the course will be observed in assessment.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Grading scale is on a pass/fail basis.
Person responsible:
Arja Haapakoski
Working life cooperation:
-
Other information:
Sign-up in WebOodi or in Tuudo.

488402S: Sustainable Development, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Process and Environmental Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Väisänen, Virpi Maria

Opintokohteen kielet: English

Leikkaavuudet:

488402A Sustainable Development 3.0 op

ECTS Credits:
5 cr / 135 hours of work
Language of instruction:
English
Timing:
Periods 3-4
Learning outcomes:
The student is able to explain the principles of sustainable development and its environmental, economic and social dimensions; knows the goals and indicators of sustainability; and is able outline the future perspectives on the prosperity of human, economic and technological systems.
Contents:
Multidisciplinary and interactive course. Lectures cover the 17 goals set by the United Nations in the 2030 Agenda for Sustainable Development. The goals address the global challenges, including those related to poverty, inequality, climate change, environmental degradation, peace and justice. As an exercise, students are given a group work assignment related to sustainability reporting. The exercise is done with the support of mentors throughout the duration of the course.
Mode of delivery:
Implemented as face-to-face teaching. The course largely relies on participatory learning, therefore, there are compulsory participation requirements.
Learning activities and teaching methods:
Lectures 34 h, guided exercise sessions 8 h, group work 43 h and independent work 50 h.
Target group:
Master’s students of environmental engineering
Prerequisites and co-requisites:
For Environmental Engineering students, admission to the Master's programme, for which minimally a former bachelor's degree is required. For other students the Bachelor level studies in process or environmental engineering or respective knowledge.
Recommended optional programme components:
Communicates with the course of Industrial Ecology, but both courses can be taken independently.
Recommended or required reading:
Will be provided during the course by the lecturers.
Assessment methods and criteria:
Answering learning tasks and participation in the group exercise, as well as completing the participation requirements in terms of the lectures and exercise sessions.

Grading:
The course evaluation will be based on the individual work done in the learning tasks and performace in the exercise participation and exercise report. The course unit utilizes a numerical grading scale 1-5 (accepted grades) and zero stands for a fail.
Person responsible:
University teacher Virpi Väisänen

488506S: Sustainable Urban Energy, 5 op

Voimassaolo: 01.08.2018 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Process and Environmental Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Eva Pongracz

Opintokohteen kielet: English

ECTS Credits:
5 cr/135 hours of work
Language of instruction:
English
Timing:
Period 4, on-line course
Learning outcomes:
The student can explain the concepts and legislative requirements for zero energy buildings and positive energy districts. The student will gain an understanding of the key technologies and key performance indicators (KPIs) of energy sustainable dwellings and sustainable city structures. The student will be able to calculate energy needs of buildings as well as greenhouse gas (GHG) emissions associated with energy consumption. The student can apply the psychometric chart and able to size and select suitable heating, ventilation and air conditioning (HVAC) technologies for different climate zones. The student can also apply energy modelling tools and is able to size building-integrated renewable energy technologies. The student calculate the renewable energy generation potential and make an economic assessment of the applied technologies in terms of payback time and net energy costs.
Contents:
Energy transition in cities, short and long-term strategies, features and KPIs of sustainable cities. Legislation and standards regarding building energy efficiency and urban energy; city energy planning for the 2030 and 2050 horizons. Building planning for energy efficiency, zero energy buildings, energy audits. Building integrated renewable energy generation and passive solar energy utilization. Basics of HVAC technologies ensuring indoor comfort and health. Applying the psychometric chart for different climate zones. Energy efficiency renovation, calculating energy efficiency gains and GHG reduction potential. Building skins and energy storage in the building structure. Practical examples and emerging technologies.
Mode of delivery:
On-line course, with pre-recorded video lectures, learning material and exercises. Live video conference and discussion.
Learning activities and teaching methods:
Self-learning, and self-assessment. Video lectures and tutorials for the calculation exercises. Learning tasks and calculation exercises. On-line and face-to-face consultation.
Target group:
Master's students of environmental engineering, especially of sustainable energy systems orientation; Doctoral students are also welcome to participate.
Recommended or required reading:
Lecture slides and information on recommended reading material will be provided during the course.

Assessment methods and criteria:
Grading of learning tasks, calculation and sizing exercises. Self-evaluation and self-assessment.
Grading:
The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.
Person responsible:
Prof. Eva Pongrácz

477415S: Thermodynamic and process modelling in metallurgy, 5 op

Voimassaolo: 28.11.2016 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Process and Environmental Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Eetu-Pekka Heikkinen

Opintokohteen kielet: English

ECTS Credits:
5 cr / 135 hours of work.
Language of instruction:
English
Timing:
The course is held in the autumn semester, during periods I and II. It is recommended to complete the course at the 5th autumn semester.
Learning outcomes:
Students passing the course can use computational methods (i.e. HSC Chemistry -software) to investigate the thermodynamic equilibria (e.g. in metallurgy). These thermodynamic considerations include 1) equilibrium calculations, 2) mass and heat balances as well as 3) phase diagrams. Additionally, they can use commercial process simulation software (i.e. HSC Sim -software) to model metallurgical processes. This means that the student will know how to 1) model flowsheets for various processes, 2) apply simulation in practical problems and 3) run calculation and analyse the results.
Contents:
Course is divided in two parts. Part I focuses on thermodynamic modelling in the contexts of metallurgy: How to use HSC Chemistry as well as its modules (Reaction equations, Equilbrium compositions, Heat & Material balances, H, S, CP, G diagrams, Stability diagrams, Eh-pH diagrams, Measure units, Periodic chart, Species converter) and database? How to define a system? How to interpret results? Part II focuses on general information and exercises in HSC-Sim (Flowsheet simulation -module): HSC-Sim structure and user interface, toolbar, drawing a flowsheets with HSC Sim, data necessary for building up a simulation, structure of HSC Sim Distribution mode, simulation of metallurgical balance.
Mode of delivery:
Classroom education
Learning activities and teaching methods:
Simulation exercises (work in pairs) supported by the contact-education, which consists of simulation exercises (48 hours). The rest is individual work outside the lectures.
Target group:
SStudents of process metallurgy.
Prerequisites and co-requisites:
Knowledge and skills obtained from the Bachelor-level-studies in engineering or science programme are required as prerequisities. In order to get credits from this course, bachelor thesis must be completed.
Recommended optional programme components:
This course is one of the courses of pyrometallurgy in the module of process metallurgy.

Recommended or required reading:
Material will be distributed during the lectures and exercises. Each student is required to search additional material for the exercises when necessary.
Assessment methods and criteria:
Continuous assessment consisting of simulation exercises and reports based on the exercises. Work in pairs. No final exams are organized.
Grading:
The course utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail
Person responsible:
university lecturer Eetu-Pekka Heikkinen
Working life cooperation:
The course includes guest lectures from the industry.
Other information:
Due to continuous assessment used in this course, it is highly recommended that the students are present already in the first lecture.

488146S: Urban water management, 5 op

Voimassaolo: 01.01.2020 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Process and Environmental Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Pekka Rossi

Opintokohteen kielet: English

Leikkaavuudet:

488141S Urban hydrology 5.0 op

ECTS Credits:
5 ECTS credits/133 hours of work
Language of instruction:
English
Timing:
The course unit is held in the spring semester, in period 3.
Learning outcomes:
Student has a knowledge on the different aspects of urban hydrology to manage waters in a built environment. Student understands the challenges concerning quantity and quality questions of urban waters and can take them into account in designing.
Contents:
Storm water system design, green infrastructure, urban erosion, drainage, flood control and climate change in urban hydrology, urban water quality and constructed wetlands.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures (30 h), homeworks (45 h) and a design exercise (58 h).

Target group:
Students in master program of environmental engineering and in master program of civil engineering.
Prerequisites and co-requisites:
AutoCAD ja Matlab prosessi- ja ympäristötekniikan työkaluna or at least equivalent information about CAD use . 477052A Fluid mechanics, 477312A Lämmön- ja aineensiirto and 488102A Hydrological Processes.
Recommended optional programme components:
This course is a straight continuation of course 488135A Water distribution and sewage networks (recommended but not prerequisite prior to this course).
Recommended or required reading:
Lecture handouts and materials, Hulevesiopas (2012, in Finnish).
Assessment methods and criteria:
Examination, seminar and a design exercise.

Grading:
The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.
Person responsible:
Postdoctoral Researcher Pekka Rossi

Working life cooperation:
Course includes guest lectures of storm water designers/consultants and/or municipalities/cities responsible for the storm water management.

Other information:
This course replaces the course 488141S Urban hydrology.

488110S: Water and Wastewater Treatment, 5 op

Voimassaolo: 01.08.2005 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Process and Environmental Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Elisangela Heiderscheidt

Opintokohteen kielet: English

Leikkaavuudet:

480151S	Water and Wastewater Treatment	7.0 op
480208S	Industrial Water and Wastewater Treatment	3.5 op

ECTS Credits:
5 ECTS credits/135 hours of work
Language of instruction:
English
Timing:
The course unit is held in the autumn semester, during period 1
Learning outcomes:
Upon completion of the course, the student will be able to understand the theory and practicalities behind the most used purification processes in water and wastewater treatment. The student will also be capable of performing basic dimensioning calculations and therefore he/she will be able to dimension structures/units of water and wastewater treatment plants and to comprehend the basic requirements of different purification processes.
Contents:
Water quality characteristics of source water; basic principles of purification processes (coagulation/flocculation, sedimentation, biological treatment, filtration, disinfection, etc); process units in water and waste water treatment; selection of process units; dimensioning of treatment structures and unit processes.
Mode of delivery:
Mix of guided self-study work, face-to-face teaching and field visits.
Learning activities and teaching methods:
Lectures (30 h), field visits (5 h), exercises and other assignments (60 h) and self-study (38 h).

Target group:
Students in master program of environmental and civil engineering.

Prerequisites and co-requisites:
The required prerequisite is the completion of the following course or to have corresponding knowledge prior to enrolling for the course unit: Introduction to process and environmental engineering (477013P) or I (477011P) and II (488010P).
Recommended or required reading:
Lecture hand-outs & “Lindquist, A., 2003. About water treatment. Helsingborg: Kemira Kemwater”. Optional: RIL 124-2, Vesihuolto II; Metcalf & Eddy, Wastewater Engineering: Treatment and Reuse; AWWA, Water quality & treatment; AWWA, Water treatment plant design.
Assessment methods and criteria:
The course can be completed in two different study modes: A) Active mode: midterm exam based on reading material + completion of 2 group exercises + final exam based on lectures and exercises; B) Passive mode (book exam): 100% self-study mode where the student is provided with 2-3 reference books and attends an exam based on the provided material. (Passive mode can be complete under special circumstances).
Read more about assessment criteria at the University of Oulu webpage.
Grading:
The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.
Person responsible:
Post-doctoral researcher Dr Elisangela Heiderscheidt
Working life cooperation:
Through visits to water and wastewater treatment plants, which include lectures provided by environmental engineers in charge and guided tours, the students familiarize with the main technological and process related principles of the field and have the chance to experience in firsthand how to deal with some of the most common issues related to water and wastewater purification systems.
Other information:
The course will be held as distance learning in the fall of 2020.