Opasraportti

Courses in English for Exchange Students, 2016-17: Process and Environmental Engineering (2016 - 2017)

This WebOodi Course Catalogue lists the courses in the study fields of **Process Engineering and Environmental Engineering** that are **available in English for exchange students** during the Academic Year **2016-2017** at the **Faculty of Technology, University of Oulu**. The courses are either lectured/taught in English, or there is a book exam available in English.

NB! Course availability: Most of the listed courses are available for all **exchange students hosted by the Faculty of Technology** (study fields of process engineering, environmental engineering, mechanical engineering, and industrial engineering and management), **if they have the required previous knowlegde**.

Please check the requirements of the course - see "Prerequisites and co-requisites" in the course's description.

If you wish to do an internship or a final thesis project during your exchange at our Faculty, you need to contact the Faculty Coordinator already when planning the exchange.

Exchange students hosted by other University of Oulu faculties have to contact the Coordinator of the Faculty of Technology (see below) to ask if it is possible to participate to the courses, but also they must have the previous knowledge required for the course in question.

When planning your exchange studies and the required **Learning Agreement**, please **use the information provided under the Courses tab** in this Catalogue.

Please read carefully the provided information for each course you wish to take (cource description, language of instruction, target group, course content, timing, preceding studies = requiered previous studies, additional information, etc.).

All incoming exchange students must **submit their Exchange Application online through the University of Oulu SoleMOVE system**, and you will **also need to submit a course plan** to that application and **enclose the respective Learning Agreement signed** by you and your home coordinator.

Further information on application process for incoming exchange students is available at http://www.oulu.fi/english/studentexchange or at international.office@oulu.fi. **For more information about the courses,** please contact Faculty Coordinator (see contact info below).

After arrival, accepted exchange students are required to **register on-line in the WebOodi system to all courses** (**and** later, to the possible final course **exams** too). Course registration takes place via the WebOodi system once you have arrived in Oulu and received your University of Oulu login information. More information on registration will be provided during Orientation. When registering to a course you will be able to find detailed information on teaching and **schedules** here under the **Instruction** and **Examinations tabs**.

Course schedules: Detailed information on teaching and schedule can be found under the **Instruction** and **Examinations tabs**. Our courses' schedules are based on so-called **periodical schedules**. Courses which are organised during **periods 1-2** are given on the **autumn** term (September-December), and respectively the **periods 3-4** refer to courses given during the **spring** term (January-May).

On the Academic Year of 2016-2017 these periods are scheduled as follows:

Orientation week: Aug 22-26, 2016
Autumn term: Period 1: Aug 29 - Oct 21, 2016;
Period 2: Oct 24 – Dec 16, 2016

Orientation week: Jan 4 - Jan 5, 2017;
Spring Term: Period 3: Jan 9 – March 10, 2017;
Period 4: March 13 – May 12, 2017
(after period 4 there can possibly be some final exams, until the end of May)

Individual course codes include information on the level of course:

xxxxxY, xxxxxP, = basic introductory level courses, for 1st-2nd year students (basic Bachelor level)
xxxxxA = subject level introductory courses, mainly for 1-3 year students (advanced Bachelor level)
xxxxxS = advanced level courses, mainly for 4-5 year students (Master level courses)

Any questions about these courses should be addressed to:

Ms. M.Sc. Marita Puikkonen
Coordinator for Faculty of Technology Student Exchange (Incoming & Outgoing Mobility) for
Process, Environmental and Mechanical Engineering, and Industrial Engineering and Management
Faculty of Technology, University of Oulu, Finland
Eddress: firstname.surname@oulu.fi

Tutkintorakenteisiin kuulumattomat opintokokonaisuudet ja -jaksot

477310S: Advanced Catalytic Processes, 5 op
477607S: Advanced Control and Systems Engineering, 5 op
488305S: Advanced Course for Biotechnology, 5 op
477223S: Advanced Process Design, 5 op
488204S: Air Pollution Control Engineering, 5 op
477508S: Automation in Metallurgical Industry, 5 op
477713S: Automation in Mineral Processing, 5 op
477507S: Automation in Pulp and Paper Industry, 5 op
488321S: Bioreactor technology, 5 op
477209S: Chemical Process Simulation, 5 op
477123S: Chemical processing of biomasses, 5 op
477525S: Computational intelligence in automation, 5 op
477621A: Control System Analysis, 5 op
477622A: Control System Design, 5 op
477624S: Control System Methods, 5 op
488201A: Environmental Ecology, 5 op
488221S: Environmental Load of Industry, 5 op
477041S: Experimental Design, 5 op
477305S: Flow Dynamics, 5 op
477052A: Fluid Mechanics, 5 op
488108S: Groundwater Engineering, 5 op
477322A: Heat and Mass Transfer, 5 op
488102A: Hydrological Processes, 5 op
488203S: Industrial Ecology, 5 op
488311S: Industrial Microbiology, 5 op
477207S: Industrial Water and Wastewater Technologies, 5 op
488104A: Industrial and municipal waste management, 5 op
488052A: Introduction to Bioproduct and Bioprocess engineering, 5 op
477126S: Manufacturing of fibre products, 5 op
477201A: 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
477623S: Process Information Systems, 10 op
477524S: Process Optimization, 5 op
477309S: Process and Environmental Catalysis, 5 op
477501A: Process dynamics, 5 op
488202S: Production and Use of Energy, 5 op
477125S: Recycling of bioproducts, 5 op
477321S: Research Ethics, 3 op
477304A: Separation Processes, 5 op
477523S: Simulation, 5 op
488402S: Sustainable Development, 5 op
488110S: Water and Wastewater Treatment, 5 op

Opintojaksojen kuvaukset

Tutkintorakenteisiin kuulumattomien opintokokonaisuuksien ja -jaksojen kuvaukset

477310S: Advanced Catalytic 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: Keiski, Riitta Liisa
Opintokohteen kielet: English
Leikkaavuudet:

480360S Catalysts in Environmental Technology 5.0 op

ECTS Credits:
5 ECTS / 133 hours of work
Language of instruction:
English
Timing:
Implementation in autumn semester during 2 nd period every even year.
Learning outcomes:
After completing the course the student can explain the interdisciplinary connection of catalysis with material and surface science, define new catalyst preparation methods and application areas, catalytic reaction and process engineering, and methods in catalyst research (experimental and computational methods). He/she is also able to design and do research work by emphasising research methods and innovations in catalysis. He/she is able to explain the latest knowledge connected to catalyst research and applications. He/she is also capable of explaining the relation and differences between heterogeneous, homogeneous and biocatalysis.
Contents:
The course contents are divided into the following themes 1) surface chemistry and catalysis, 2) new catalyst preparation methods, 3) catalysis for a sustainable production and energy, and green chemistry and engineering

and catalysis, 4) design of catalysts and catalytic processes (reactor and process intensification, process improvements, new catalysts and catalytic processes, new opportunities by catalysis), 5) phenomena integration and catalysis and 6) new innovations in catalyst research.
Mode of delivery:
Lectures and a seminar work, face-to-face teaching
Learning activities and teaching methods:
Lectures 30 h, seminar work 25 h, self-study 78 h.
Target group:
Master's degree students of the Process and Environmental Engineering study programmes.
Prerequisites and co-requisites:
The courses 477309S Process and Environmental Catalysis and 488204A Air Pollution Control Engineering.
Recommended optional programme components:
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Recommended or required reading:
Thomas, J.M. & Thomas, W.J.: Principles and Practice of Heterogeneous Catalysis. Weinheim 1997. 657 p.; Somorjai, G.A.: Surface Chemistry and Catalysis. New York 1994. 667 p.; Van Santen, R.A., van Leuwen, P.W.N. M., Moulijn, J.A. & Averill, B.A.: Catalysis: An Integrated Approach, 2nd. edition. Research Articles.
Further literature: Ertl, G., Knözinger, H. &Weitkamp, J.: Handbook of Heterogeneous Catalysis. Vol. 1-5. Weinheim 1997; Morbidelli, M., Gavriilidis, A. &Varma, A.: Catalyst Design, Optimal Distribution of Catalyst in Pellets, Reactors, and membranes. New York 2001, Cambridge University Press. 227 p.; Anastas, P.T. & Crabtree, R.H. (eds.): Green catalysis, volume 2: Heterogeneous Catalysis. Weinheim 2009, 338 p.
Assessment methods and criteria:
Written examination and a seminar work including reporting and 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 utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.
Person responsible:
University researcher Satu Ojala
Working life cooperation:
No
Other information:
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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 / 133 hours of work
Language of instruction:
Finnish (English if necessary)
Timing:
Period 3 (spring term)
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 477602A Control system analysis, 477603A Control system design, 4776xxS Control system methods, 477605S Digital control theory recommended beforehand
Recommended optional programme components:
None
Recommended or required reading:
Materials distirbuted during the contact teaching and through the course web pages
Assessment methods and criteria:
Exam and homework
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 1.5 or fail
Person responsible:
Professor Enso Ikonen
Working life cooperation:
No
Other information:
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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: Sanna Taskila

Opintokohteen kielet: English

Leikkaavuudet:

480450S Bioprocesses III 5.0 op

ECTS Credits:
5 ECTS /133 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 and metabolites.
Contents:
Microbial homologous and heterologous protein production. Physiological and process related items in the production of selected microbial metabolites. Methods for process intensification. Scale-up of bioprocesses. Unit operations in product recovery and purification.
Mode of delivery:
Blended teaching.
Learning activities and teaching methods:
Lectures 36 h / homework 48 h / self-study 49 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 488309A Biocatalysis, 488052A Introduction to Bioproduct and Bioprocess Engineering and 488304S Bioreactor technology, or respective knowledge.
Recommended optional programme components:
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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. 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:
Dr. Sanna Taskila
Working life cooperation:
No
Other information:
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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

Opintokohteen kielet: English

Leikkaavuudet:

477206S	Advanced Process Design	6.0 op

ECTS Credits:
5 ECTS /133 hours of work
Language of instruction:
English
Timing:
Spring, period 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 optional programme components:
Part of Process Design Module
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 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 Lecturer Juha Ahola
Working life cooperation:
No
Other information:
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488204S: Air Pollution Control 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: Satu Pitkäaho

Opintokohteen kielet: English

Leikkaavuudet:

ay488204S	Air Pollution Control Engineering (OPEN UNI)	5.0 op
488213A	Sources and control of air pollution	5.0 op
480380S	Air Protection Techniques	5.0 op

ECTS Credits:
5 ECTS credits / 133 hours of work
Language of instruction:
English
Timing:
Implementation in autumn semester during 2 nd period.
Learning outcomes:
The student is able to explain what kind of air emissions originate from certain industries and power plants, and can explain their environmental and health impacts. The student is able to explain the common air pollution control systems for different emissions (SO2, NOx, VOC, CO2, dust) and is able to design air pollution cleaning devices. He/she can describe how air emissions are measured. In addition, the student is able to describe the main laws related to air emission control.
Contents:
Effects of pollution on the atmosphere. Acid rain. Climate change. Ozone. Effects of pollution on health, nature and buildings. Legislation. Emission measurements. Emission control technologies; VOC emissions, SO_x emissions, NO_X emissions etc.Motor vehicle problem, CO, lead, HAP and Indoor air pollution.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 30h, exercises 10h and self-study 93 h.
Target group:
Master's degree students of the Process and Environmental Engineering study programmes.
Prerequisites and co-requisites:
The courses 477011P Introduction to Process and Environmental Engineering I, 488011P Introduction to Process and Environmental Engineering II and 780109P Basic Principles in Chemistry recommended beforehand.
Recommended optional programme components:
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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 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:
Postdoctoral researcher Satu Pitkäaho
Working life cooperation:
No
Other information:
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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: Leiviskä, Kauko Johannes

Opintokohteen kielet: English

ECTS Credits:
5 ECTS /133 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.
Prerequisites and co-requisites:
-
Recommended optional programme components:
-
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.
Grading:
The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.
Person responsible:

Professor Kauko Leiviskä
Working life cooperation:
No
Other information:
-

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: Leiviskä, Kauko Johannes

Opintokohteen kielet: Finnish

Leikkaavuudet:

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

ECTS Credits:
5 ECTS /133 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 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 optional programme components:
-
Recommended or required reading:
Lecture notes in English
Assessment methods and criteria:
Continuous evaluation: lectures and test
Grading:
The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.
Person responsible:
Professor Kauko Leiviskä
Working life cooperation:
No
Other information:
-

477507S: Automation in Pulp and Paper Industry, 5 op

Voimassaolo: 01.08.2005 - 31.07.2021

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Process and Environmental Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Leiviskä, Kauko Johannes

Opintokohteen kielet: English

Leikkaavuudet:

470338S Process Control in Pulp and Paper Industry 3.5 op

ECTS Credits:
5 ECTS /133 hours of work
Language of instruction:
English
Timing:
No set schedule. Contact the responsible person.
Learning outcomes:
After the course, the student knows the management and control problems in pulp and paper industry and can choose between the main means to solve them. He knows also the need and practice of special measurements on this area. 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 pulp and paper industry.
Contents:
Control systems and methods, special measurements, automation in pulp industry (fibres, chemicals, mechanical pulping, paper machines, mill-wide automation), process analysis, modelling, and simulation. Application of intelligent methods in paper industry.
Mode of delivery:
Individual work (self-study/group work); no lectures given
Learning activities and teaching methods:
The course includes a literature review of a given topic done in groups of 2-3 students and a written test from the book given below. The course can be taken any time regardless of teaching periods.
Target group:
Master's students in study programmes Process or Environmental Engineering /study option Automation Technology. Exchange and other international students of the field.
Prerequisites and co-requisites:
Course Pulp and Paper Technology recommended beforehand
Recommended optional programme components:
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Recommended or required reading:
Leiviskä, K.: Process Control. Book 14. Papermaking Science and Technology Series. Fapet Oy 1999.
Assessment methods and criteria:
Book examination, literature report.
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:
Professor Kauko Leiviskä
Working life cooperation:
No
Other information:
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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

Opintokohteen kielet: English

Leikkaavuudet:

488304S Bioreactor Technology 6.0 op

ECTS Credits:
5 ECTS /133 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 apply different mathematical formulas for biocatalysis and for the bioreactor performance and use those to plan and analyze bioprocesses. The student will also be able to produce, analyze and interpret data from 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 Micahelis-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. Power consumption. Scale-up and scale-down.
Mode of delivery:
Blended teaching.
Learning activities and teaching methods:
Lectures 50 h / exercises 8 h / homework 16 h / self-study 59 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 488309A Biocatalysis, 488052A Introduction to Bioproduct and Bioprocess Engineering) or respective knowledge.
Recommended optional programme components:
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Recommended or required reading:
Lectures: Lecture hand outs; Doran, P. M. Bioprocess engineering principles. Academic Press. London, 2010. upplementary material: Villadsen J., Nielsen J., Liden G. Bioreactor engineering principles. Springer Verlag, 2011. Shuler ML., Kargi F. Bioprocess engineering basic consepts. 2nd ed. Pearson. 2002 and 2014.
Assessment methods and criteria:
Lectures, exercises, final exam, homework. Grade will be composed of final exam, exercises and homework. 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:
Dr Johanna Panula-Perälä
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: Jani Kangas

Opintokohteen kielet: English

ECTS Credits:
5 ECTS /133 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:
The structure of a process simulator. Thermodynamic property models and databanks. Degrees of freedom analysis. Steady-state simulation. Sequential modular, and equation-oriented approaches in simulation. Numerical solving methods. Heuristics for chemical process simulation.
Mode of delivery:
Face-to-face teaching, introductory examples and group exercises with process simulation software.
Learning activities and teaching methods:
Guided exercises 46 h and group work 87 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. 3 rd 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:
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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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

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 indentify lignocellulosic raw material sources, their properties, their main components and utilization potential of components. The student also indentifies 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 identifies biorefining concepts of chemical pulp components (cellulose, hemicelluloses, lignin and extractives) into high value products; cellulose derivatives, special fibres, nanofibrillar and micronized celluloses, and green chemicals.
Contents:
Lignocellulosic raw materials, fundamentals of chemical pulping, recovering of chemicals in kraft pulping, bleaching of pulp. High value biomass products by biorefining (e.g. nanocelluloses and soluble celluloses).
Mode of delivery:
Blended teaching.
Learning activities and teaching methods:
The implementation methods of the course vary. Lectures and exercises 32 h, web learning 64 h, and self-study 37 h. A part of teaching can be replaced by group works or home works.
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 lecture diarys, self tests during web learning and three intermediate exams. Alternatively, the course can also be completed by taking the end exam. 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:
Ari Ämmälä
Working life cooperation:
No
Other information:
-

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

Opintokohteen kielet: Finnish

Leikkaavuudet:

477505S	Fuzzy-neuromethods in Process Automation	4.0 op

ECTS Credits:
5 ECTS / 133 hours of work
Language of instruction:
Finnish and English
Timing:
Implementation in the autumn term, on hte 2nd period. Recommended for fourth 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 recognizes the key problems of the data-driven modelling and is able to choose suitable solutions which ensure generalization. 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. Moreover, the student is able to describe alternative solutions for dynamic models, hyperplane methods and hybrid solutions. The student can explain the key concepts of cellular automata and evolutionary computation. After the course the student is able to search other relevant programming tools.

Contents:
Fuzzy logic and fuzzy set systems, fuzzy calculus, fuzzy modeling and control, neural computation, learning algorithms, neuro-fuzzy methods, linguistic equations, evolutionary computation, hyperplane methods, cellular automata, intelligent diagnostics and decision making, adaptive intelligent systems, hybrid systems.

Mode of delivery:
Tuition is implemented mainly as face-to-face teaching.

Learning activities and teaching methods:
The amount of guided teaching is 32 hrs, including lectures (16), exercises (10) and seminars 6). Totally 58 hrs 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 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 exercise materials. Material is in Finnish and in English.

Assessment methods and criteria:
The assessment of the course is based on the exercises, case study, seminar and the final report. Final exam is an alternative for the final report.
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:
D.Sc. (Tech.) Esko Juuso

Working life cooperation:
No

Other information:
-

477621A: Control System Analysis, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Process and Environmental Engineering

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

477602A	Control System Analysis	4.0 op

ECTS Credits:
5 ECTS / 133 hours of work

Language of instruction:
Finnish

Timing:
Period 1 (autumn term)

Learning outcomes:

After completing the course the student can describe the process dynamics with mathematical and graphical methods. The student can independently: form linear process models, analyse linear system stability, Bode diagrams, Routh’s stability criterion and the Jury's test, and evaluate the behavior of processes through time and frequency range specifications.

Contents:
Introduction to Matlab. Laplace-transforms. Transfer functions and block diagrams. Dynamical systems. Time and frequency analysis. System stability.

Mode of delivery:
Face-to-face teaching

Learning activities and teaching methods:
Lectures and exercises

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

Prerequisites and co-requisites:
The courses 477011P Introduction to process and environmental engineering I, 488010P Introduction to process and environmental engineering II, and 477051A Automation engineering recommended beforehand

Recommended optional programme components:
None

Recommended or required reading:
Materials delivered at the lectures and exercises. Dorf, R. (2010) Modern Control System. 12th ed. Prentice-Hall. 1104 pp. Additional literature: Ogata, K. (2002) Modern Control Engineering. 4th ed. Prentice-Hall. 964 pp., DiStefano, J. (1990) Feedback and Control Systems. 2nd ed. Prentice-Hall. 512 pp.; Ylen; J-P. (1994) Säätötekniikan harjoitustehtäviä. Hakapaino Oy. 252 pp.

Assessment methods and criteria:
Exam and in addition extra points from homeworks

Grading:
Numerical grading scale 1-5 or fail

Person responsible:
Lecturer Jukka Hiltunen and university teacher Seppo Honkanen

Working life cooperation:
No

Other information:
-

477622A: Control System Design, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Process and Environmental Engineering

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

477603A	Control System Design	4.0 op

ECTS Credits:
5 ECTS / 133 hours of work

Language of instruction:
Finnish

Timing:
Period 3 (spring term)

Learning outcomes:
After completing the course the students can apply mathematical and graphical methods to the dynamics of process characterisation and control design. The student can form PID controllers for the process, and tune them and evaluate the closed-loop requirements.

Contents:
Laplace-level vs, time level, poles of the system, closed loop and its design specifications, PID control and tuning, Matlab control designer tool, control design in frequency domain

Mode of delivery:
Face-to-face teaching

Learning activities and teaching methods:
Lectures and exercises
Target group:
B.Sc. students in process and environmental engineering
Prerequisites and co-requisites:
The courses 477011P Introduction to process and environmental engineering I, 488010P Introduction to process and environmental engineering and 477602A Control system analysis recommended beforehand
Recommended optional programme components:
None
Recommended or required reading:
Lecture and exercise handouts. Åström, K & Murray, R. (2009) Feedback Systems, An Introduction for Scientists and Engineers. Princeton University Press, New Jersey, 396 s. Additional literature: Dorf, R (2010) Modern Control Systems. Prentice-Hall, New York, 1104 s., DiStefano, J (1990) Schaum's Outline of Feedback and Control Systems. 2nd ed, McGraw-Hill, 512 s. ja Ylen, J-P (1994) Säätötekniikan harjoitustehtäviä. Hakapaino Oy, 252 s.
Assessment methods and criteria:
Exam
Grading:
Numerical grading scale 1-5 or fail
Person responsible:
Professor Enso Ikonen and university teacher Seppo Honkanen
Working life cooperation:
No
Other information:
-

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

Opintokohteen kielet: Finnish

Leikkaavuudet:

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

ECTS Credits:
5 ECTS / 133 hours of work
Language of instruction:
Finnish
Timing:
Period 1 (autumn term)
Learning outcomes:
After completing the course students can identify the problems of the sampled data systems, and know how to apply discrete time methods for systems analysis and control design.
Contents:
1. Control systems design by frequency-response methods. 2. Control systems design in state space methods 3. Sampled data systems: sampling, Z transformation of signals. 4. Discrete-time modelling: difference equation, shift operator, pulse transfer function, polynomial and state-space description. 5. Analysis of discrete-time systems: z-plane, stability. 6. Discrete-time control design strategies: general RST structure, various pole-zero placement control algorithms, minimum-variance control, model-based control, state-space design methods.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures and exercises include guided computer simulations
Target group:
M.Sc. students in process and environmental engineering
Prerequisites and co-requisites:

The courses 477602A Control system analysis and 477603A Control system design recommended beforehand
Recommended optional programme components:
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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. 544 pp.
Assessment methods and criteria:
Final written exam; to request an exam in English, contact the lecturer via email beforehand.
Grading:
Numerical grading scale 1-5 or fail
Person responsible:
University teacher Seppo Honkanen
Working life cooperation:
No
Other information:
-

488201A: Environmental Ecology, 5 op

Voimassaolo: 01.08.2005 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Process and Environmental Engineering

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: English

Leikkaavuudet:

488210A	Environmental science and technology	5.0 op
ay488201A	Environmental Ecology (OPEN UNI)	5.0 op
488406A	Introduction to Environmental Science	5.0 op
480001A	Environmental Ecology	5.0 op

ECTS Credits:
5 ECTS credits / 133 hours of work
Language of instruction:
English
Timing:
Implementation in spring semester during 4 th period. It is recommended to complete the course at the first (Bachelor's) spring semester.
Learning outcomes:
Upon completion of the course, the student is able to define the basic concepts of environmental ecology. He/she has knowledge about the state of the environment and is able to explain the essential environmental problems and the main effects of pollution. In addition, the student knows some solutions to environmental problems and is aware of ethical thinking in environmental engineering. The student also has basic knowledge about toxicology and epidemiology.
Contents:
Principles of environmental ecology. Roots of environmental problems. Global air pollution: ozone depletion, acid deposition, global warming and climate change. Water pollution, eutrophication, overexploitation of ground and surface water. Main effects of pollution and other stresses. Non-renewable and renewable energy. Energy conservation and efficiency. Hazardous and solid waste problem. Principles of toxicology, epidemiology, and risk assessment. Environmental ethics.
Mode of delivery:
Web-based teaching.
Learning activities and teaching methods:
Book examination 80 h / exercises as individual work 53 h.
Target group:
Bachelor's degree students of environmental engineering.

Prerequisites and co-requisites:
The courses 477011P Introduction to Process and Environmental Engineering I and 488011P Introduction to Environmental Engineering recommended beforehand.
Recommended optional programme components:
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Recommended or required reading:
Chiras D.: Environmental Science. New York, Jones and Bartlett Publishers, 9 th edition, 2013.
Assessment methods and criteria:
All students complete the course in a final examination. Also the exercises will be assessed. The assessment of the course is 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
Other information:
-

488221S: Environmental Load of Industry, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Process and Environmental Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Niina Koivikko

Opintokohteen kielet: English

Leikkaavuudet:

488215S	Industry and Environment	5.0 op
488205S	Environmental Load of Process Industry	4.0 op

ECTS Credits:
5 ECTS credits / 133 hours of work
Language of instruction:
English
Timing:
Implementation in spring semester during 3 rd period.
Learning outcomes:
The student is able to identify the essential features of the environmental load in different types of (chemical, wood, metallurgical,…) industry. He/she is able to explain the type, quality, quantity and sources of the emissions. The student is familiarized with the main emission control systems and techniques in different industrial sectors. He/she has the skills to apply BAT-techniques in emission control. The student can explain the environmental management system of an industrial plant and is able to apply it to an industrial plant.
Contents:
Effluents: types, quality, quantity, sources. Unit operations in managing effluents, comprehensive effluent treatment. Environmental management systems, environmental licences, environmental reporting and BAT.
Mode of delivery:
Face-to-face teaching.
Learning activities and teaching methods:
Lectures 40 h, self-study 93h.
Target group:
Master's degree students of the Process and Environmental Engineering study programmes.
Prerequisites and co-requisites:
The courses 477011P Introduction to Process and Environmental Engineering I, 488011P Introduction to Process and Environmental Engineering II, 488204S Air Pollution Control Engineering and 488110S Water and Wastewater Treatment recommended beforehand.
Recommended optional programme components:

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Recommended or required reading:
Material represented in lectures and in the Optima environment.
Assessment methods and criteria:
Written final exam or a learning diary.
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:
Academy research fellow Satu Ojala
Working life cooperation:
No
Other information:
The expert lecturers may be invited from industry to give specific lectures related to the organization.

477041S: Experimental Design, 5 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Process and Environmental Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Leiviskä, Kauko Johannes

Opintokohteen kielet: English

ECTS Credits:
5 ECTS /133 hours of work
Language of instruction:
English
Timing:
Implementation in the 3rd period (spring term)
Learning outcomes:
After this course the student knows the main methods and software tools for experiment design and is able to use them. He can apply the main approaches for studying and evaluating the measurement reliability.
Contents:
Determining the uncertainty of measurements in chemical, physical and biochemical measurements, measurements reliability and traceability; Calculation examples support the learning of the assessment preparation for measurements uncertainty; Experimental design preparation and execution in process analysis and optimization. Test methods and variable significance, reliability of experimental data; Practical experiment design exercise using a simulation model and Modde software.
Mode of delivery:
Lectures and practical work
Learning activities and teaching methods:
Contact lectures
Target group:
Master's students in the study programmes of Process or Environmental Engineering; exchange students; doctoral students
Prerequisites and co-requisites:
No prerequisites
Recommended optional programme components:
-
Recommended or required reading:
Reading materials given during the lectures
Assessment methods and criteria:
Assessment during the course by continuous evaluation: lecture exams and the written report of the practical work.
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:
Professor Kauko Leiviskä
Working life cooperation:

No
Other information:
-

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 / 133 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 25 h, and exercise 15 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:
Laboratory manager Dr Esa Muurinen
Working life cooperation:
No
Other information:
-

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

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. Macroscopic balances. 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., Young, D.F. & Okiishi, T.H. Fundamentals of Fluid Mechanics.
Assessment methods and criteria:
This course utilizes continuous assessment. During the course there are 5 intermediate exams. 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
Other information:
-

488108S: Groundwater Engineering, 5 op

Voimassaolo: - 31.07.2017

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Process and Environmental Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Björn Klöve

Opintokohteen kielet: English

Leikkaavuudet:

480122A Groundwater Technology 5.0 op

ECTS Credits:
5 ECTS /133 hours of work
Language of instruction:
English
Timing:
The course unit is held in the spring semester, during period 4
Learning outcomes:
Upon completion of the course, the student will have knowledge on water retention and flow in soils, basic theories about hydraulics of groundwater systems, groundwater quality, groundwater use and modelling. Students learn to define hydraulic characteristics of soil and aquifers. After the course students are able to estimate key factors influencing on discharge and water quality of groundwater and to use general methods to calculate groundwater flow. They also know how to plan, manage, and protect groundwater resources in a sustainable way.
Contents:
Soil and groundwater, water balance, hydraulic properties of soils, formation of groundwater, flow equations and solutions, pumping tests and methods, groundwater quality and modelling.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 10 h, calculus exercises 9 h, MODFLOW modelling exercises 16 h, modelling report 40 h, and self-study 60 h
Target group:
Master students in the Water Engineering study options of the Environmental Engineering program
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 optional programme components:
-
Recommended or required reading:
Lecture handouts, Physical and Chemical Hydrogeology (Domenico PA, Schwartz FW, 2nd edition, 1998, ISBN 0-471- 59762-7). 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:
Modelling assignment (40 % of the grade) and exam (60 % of the grade).
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:
Postdoctoral Researcher Pekka Rossi
Working life cooperation:

No
Other information:
-

477322A: Heat and Mass Transfer, 5 op

Voimassaolo: 01.08.2015 - 31.07.2019
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:

477323A	Mass and Heat Transfer	5.0 op
477302A	Heat Transfer	3.0 op
477303A	Mass 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 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:

(Will be announced later)
Assessment methods and criteria:
This course utilizes continuous assessment. During the course there are 5 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:
-

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 /133 hours of work
Language of instruction:
Finnish, course can also be completed in English as a self-study/book exam
Timing:
The course unit is given in the autumn semester during period 1. Also the English version of the course is only available in the autumn semester.
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 relation to snowmelt, evaporation, infiltration and groundwater flow. After couse student have knowledge also to design pipe and open channel projects.
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, open channel flow, flow in pipe systems.
Mode of delivery:
Face-face teaching in Finnish, self-study package in English
Learning activities and teaching methods:
For the English self-study package, 4 tutor sessions are arranged during the autumn semester
Target group:
Students in international programs of environmental engineering
Prerequisites and co-requisites:
No
Recommended optional programme components:
The course is a prerequisite for 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:
Both hydrology and hydraulics 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 assignments (80%) and examination (20%)

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:
University Lecturer Anna-Kaisa Ronkanen
Working life cooperation:
No
Other information:
-

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 / 133 hours of work
Language of instruction:
English
Timing:
Implementation in autumn semester during 2 th 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 73 h. The exercises are completed as guided group work.
Target group:
Master’s degree students of process and environmental engineering.
Prerequisites and co-requisites:
-
Recommended optional programme components:
-
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
Other information:

-

488311S: Industrial Microbiology, 5 op

Voimassaolo: 01.08.2014 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Process and Environmental Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Sanna Taskila

Opintokohteen kielet: English

Leikkaavuudet:

488310S Laboratory Course in Microbiology 2.0 op

ECTS Credits:
5 ECTS /133 hours of work
Language of instruction:
English
Timing:
The course is held as intensive course in autumn semester during period 2
Learning outcomes:
After completing this course, the student will be able to operate in a microbiological laboratory. The student will be able to handle and cultivate microbes, follow the growth of microbes, and to apply these methods to different microbes. Student will be able to write a laboratory diary.
The student will be able to plan and conduct bench-scale research on biotechnical processes using aseptic techniques, and to evaluate and report the results of her/his research. The student will learn to apply microbes for the production of relevant biochemicals, to conduct analyses and mathematically examine the performance of studied production systems, to evaluate the challenges in up-scaling of the system, and to compare the results of research to existing literature.
Contents:
The topic of the course is related to current topics in biotechnology. The work will include laboratory exercises in the area of biocatalysis under supervision of researchers and a written final report including results of laboratory work. An industry excursion related to the course topic is arranged in Oulu area when possible.
Mode of delivery:
Face-to-face teaching.
Learning activities and teaching methods:
Lectures 2 h/ laboratory exercises 70 h/ written report 35 h / self-study 26 h.
Target group:
Master’s students of bioprocess engineering.
Prerequisites and co-requisites:
Courses 488309A Biocatalysis, 488052A Introduction to Bioproduct and Bioprocess Engineering, 488321S Bioreactor technology, or respective knowledge.
Recommended optional programme components:
-
Recommended or required reading:
Working instructions; current publications and textbooks etc. on microbiology, biotechnology and environmental engineering.
Assessment methods and criteria:
Grade will be composed of supervised practical laboratory exercises and written report.
Grading:
The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.
Person responsible:
Dr. Sanna Taskila
Working life cooperation:
No
Other information:
-

477207S: Industrial Water and Wastewater Technologies, 5 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Process and Environmental Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Tiina Leiviskä

Opintokohteen kielet: Finnish

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 period 3
Learning outcomes:
After completing the course student knows water use and management of water-intensive industrial sectors. He /she knows industrial raw water, process water and waste water treatment technologies and can evaluate optimal usage of water by considering external requirements as well as technical and economical factors. He/she can select water treatment operations on the basis of case-specific needs.
Contents:
Industrial water management. Physical, chemical and biological water treatment operations used by process industry. Detailed description of chemical water treatment processes. Pre-treatment of raw water, treatment of process water and water reuse, waste water treatment, disinfection.
Mode of delivery:
Lectures, group work and self-study
Learning activities and teaching methods:
Lectures 30h, group work 10h and self-study 90h
Target group:
Master's students e.g. in the Process Design study option
Prerequisites and co-requisites:
-
Recommended optional programme components:
Part of Process Design Module
Recommended or required reading:
Material distributed in lectures. Additional literature, McCabe, W., Smith, J., Harriot, P.: Unit Operations of Chemical Engineering; Sincero, A., Sincero, A.: Physical-Chemical Treatment of Water and Wastewater, IWA Publishing, CRC Press
Assessment methods and criteria:
The students will be making an essay and a group exercise, which both will be evaluated. Student will participate in final exam after 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 unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.
Person responsible:
Dr Tiina Leiviskä
Working life cooperation:
No
Other information:
-

488104A: Industrial and municipal waste management, 5 op

Voimassaolo: 01.08.2005 - 31.07.2017

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Process and Environmental Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Elisangela Heiderscheidt

Opintokohteen kielet: English

Leikkaavuudet:

480160S Waste Management of Communities and Industry 5.0 op

ECTS Credits:
5 ECTS /133 hours of work
Language of instruction:
English
Timing:
The course unit is organized in the autumn semester, during period 1
Learning outcomes:
The student will acquire a wider view of what is waste and how it is generated and managed in communities and industries. Student will be familiar with waste management hierarchy and how waste legislation regulates waste management. She/he will get basic knowledge about waste treatment methods including their sustainability and related environmental impacts. As well as, how a series of factors influence the planning of waste management activities in industries and municipalities. The student will also be able to understand the energy and material recovery potential within the waste sector.
Contents:
Waste management hierarchy, waste prevention principle, municipal waste management, waste management in industries, waste legislation, municipal and industrial waste treatment methods, international treaties related to waste management (Basel Convention and Clean Development Mechanism Projects: Carbon Trading), waste to energy principle.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures (28 h), group work (45 h), self-study for examination (55,5 h) and field visits (4 h)
Target group:
Students in bachelor program of environmental engineering
Prerequisites and co-requisites:
-
Recommended optional programme components:
-
Recommended or required reading:
Lecture hand-outs, notes and other materials delivered in lectures. Waste management: a reference handbook illustrated edition, 2008 (electronic book, ISBN 9781598841510).
Assessment methods and criteria:
A) Active learning method: Composed of specialized lectures, individual and groups exercises. The student is assessed via completion of 2 exercises and a final exam (passed grade obligatory on exercises and exam). This method of course completion optimizes learning outcome. OR:
B) Book examination: 100% self-study option. Under special circumstances (to be discussed with responsible teacher) when the student cannot take the active learning method the teacher will provide reading material (from one to several books) and the student will take an exam arranged within or outside the course schedule.
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:
Reseacher Elisangela Heiderscheidt
Working life cooperation:
No
Other information:
-

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: Maria Salmela-Karhu

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 /133 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, recycling of biomaterials, bioenergy, and economical and environmental aspects. 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 respective knowledge in biocatalysis.
Recommended optional programme components:
-
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:
Lectures, intermediate exams and/or final exam. Grade will be composed of lecture exams and/or final exam. 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 Johanna Panula-Perälä, Adjunct professor Ari Ämmälä
Working life cooperation:
No
Other information:
-

477126S: Manufacturing of fibre products, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Process and Environmental Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Maria Salmela-Karhu

Opintokohteen kielet: Finnish

Leikkaavuudet:

477107S	Paper Manufacture	3.0 op
477106S	Recycled Fiber Processes	3.0 op

ECTS Credits:
5 ECTS / 133 h of work
Language of instruction:
Finnish. Possible to complete also in English as a book examination.
Timing:
Implementation in spring period 4
Learning outcomes:
Upon completion of the course, a student should be able to identify the unit operations paper and board manufacturing and can explain their purpose of use. The student can name the most important chemicals, fillers and coating pigments and can explain their importance in paper and board making. The student can present the essential properties of papermaking fibres, the structure and properties of paper and board, as well as different paper and board grades. The student knows the fundamentals of printing technology and indentifies paper properties essential for printing.
Contents:
Properties of fibers, web forming, chemicals in paper manufacture, coating process, structure and properties of paper, paper processing, paper grades, and fundamentals of printing technology.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures and case studies, excursion to paper mills and printing laboratory.
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, books 8-11, and 13. Lecture materials and other materials that will be announced at the lectures.
Assessment methods and criteria:
Exam and case studies. Book exam in English is possible for foreign students. 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:
Timo Jortama, Ari Ämmälä
Working life cooperation:
No
Other information:
-

477201A: Material and Energy Balances, 5 op

Voimassaolo: 01.08.2005 - 31.12.2019

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Process and Environmental Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Tiina Leiviskä

Opintokohteen kielet: Finnish

Leikkaavuudet:

477221A	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:
Autumn period 1
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.
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
Prerequisites and co-requisites:
Basics from the course Introduction to Process Engineering
Recommended optional programme components:
-
Recommended or required reading:
Reklaitis, G.V.: Introduction to Material and Energy Balances. John Wiley & Sons, 1983. ISBN 0-471-04131-9.
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.
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:
Dr Tiina Leiviskä
Working life cooperation:
No
Other information:
-

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

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 32 h, web learning 64 h, and self-study 37 h. A part of teaching can be replaced by group works or home works.
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 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 lecture diarys, self tests during web learning and three intermediate exams. Alternatively, the course can also be completed by taking the end exam. Read more about the course assessment and grading systems of the University of Oulu at www.oulu.fi/english/studying/assessment.
Grading:
This course utilizes continuous assessment including lecture diarys, self tests during web learning and three intermediate exams. Alternatively, the course can also be completed by taking the end exam.
Person responsible:
Ari Ämmälä
Working life cooperation:
No
Other information:
-

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: Leiviskä, Kauko Johannes

Opintokohteen kielet: English

Leikkaavuudet:

480452S	Bioprocess Modelling and Control	5.0 op

ECTS Credits:
5 ECTS /133 hours of work
Language of instruction:
English
Timing:
Implementation in the 1st period (autumn term)
Learning outcomes:
After the course, the student can model kinetics and dynamics of bio-technical processes (mainly fermentation) starting from the process phenomena and mass balance models. He also understands the limitations of different approaches and the modelling assumptions. He also has preliminary skills to write models in Matlab/Simulink environment.
Contents:

Bioreactors: models, kinetics and transfer phenomena. Models: different modelling approaches with examples. Control of 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 optional programme components:
-

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
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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 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:
Professor Kauko Leiviskä, Dr Aki Sorsa

Working life cooperation:
No

Other information:
-

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: Ainassaari, Kaisu Maritta, 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, John Wiley & Sons, 1993, 579 p.; Henley, E.J. &Seader, J.D.: Equilibrium-stage Separation Operations in Chemical Engineering, John Wiley & Sons, 1982, 742 p.
Additional literature: Walas, S.M.: Phase Equilibria in Chemical Engineering, Butterworth Publishers, 1985, 671 pp.

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 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:
Laboratory manager Dr Esa Muurinen

Working life cooperation:
No

Other information:
-

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: Keiski, Riitta Liisa

Opintokohteen kielet: English

Leikkaavuudet:

470222A	Reactor Analysis and Design II	5.0 op

ECTS Credits:
5 ECTS / 133 hours of work

Language of instruction:
English

Timing:

Implementation in the autumn semester during the 2nd period. It is recommended to complete the course at the fourth (1st Master's) autumn 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.

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, face-to-face teaching.

Learning activities and teaching methods:

Lectures 35 h, exercises 12 h, homework 12 h, self-study 74 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 optional programme components:

-

Recommended or required reading:

Nauman, E.B.: Chemical Reactor Design. New York, John Wiley & Sons.1987; Winterbottom, J.M. & King, M.B. (Editors) Reactor Design for Chemical Engineers. Padstow 1999, T.J. International Ltd. 442 s.
Additional literature: 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:

Examination. Homework assignments affect the course grade. 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:

Professor Riitta Keiski

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 / 133 hours of work

Language of instruction:

Finnish

Timing:

Period 4 (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 optional programme components:
The course is followed by course 477612S Power Plant Control
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, Ph. D. student Laura Niva and lecturer Tero Hietanen (OAMK, Oulu University of Applied Sciences)
Working life cooperation:
No
Other information:
-

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: Jani Kangas

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:
By completing the course the student is able to identify the activities of process design and the know-how needed at different design stages. The student can utilise process synthesis and analysis tools for creating a preliminary process concept and point out the techno-economical performance based on holistic criteria.
Contents:
Acting in process design projects, safety and environmentally conscious process design. Design tasks from conceptual design to plant design, especially the methodology for basic and plant design.
Mode of delivery:
Lectures and design exercises.
Learning activities and teaching methods:
Lectures 30h, group work 50h and self-study 50h
Target group:
Bachelor students
Prerequisites and co-requisites:
Objectives of 477202A Reactor analysis and 477304A Separation processes
Recommended optional programme components:
-
Recommended or required reading:
Lecture handout, 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:
Combination of examination and 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:
-

477623S: Process Information Systems, 10 op

Voimassaolo: 01.08.2015 - 31.07.2021

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Process and Environmental Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Hiltunen, Jukka Antero

Opintokohteen kielet: Finnish

Leikkaavuudet:

477610S	Process Information Systems	5.0 op
477606S	Fault Diagnosis and Process Performance Analysis	2.0 op

ECTS Credits:
10 ECTS / 266 hours of work
Language of instruction:
Finnish
Timing:
Periods 3-4 (spring term)
Learning outcomes:
After completing the course the student can implement performance-enhancing and maintenance systems, and plan, evaluate and develop also other large scale automation and information systems.
Contents:
Model- and data-based diagnostic methods. Measurement validation. Process performance assessment and follow-up. Application examples. Industrial Internet: Purpose of information systems. Technologies used in wide information systems. Case study analyses.
Mode of delivery:

Face-to-face teaching
Learning activities and teaching methods:
Seminars. The course is given every second year during two periods.
Target group:
M.Sc. students of process and environmental engineering
Prerequisites and co-requisites:
The course 477051A Automation Engineering recommended beforehand
Recommended optional programme components:
-
Recommended or required reading:
Will be announced later
Assessment methods and criteria:
Learning diary, seminars and exam
Grading:
Numerical grading scale 1-5 or fail
Person responsible:
Lecturer Jukka Hiltunen
Working life cooperation:
No
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 /133 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 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. Hierarchical optimization. Intelligent methods in optimization. Applications in process engineering.
Mode of delivery:
Face-to-face teaching and exercises as group work
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 solved exercises and lecture exams. Final exam is also possible.
Grading:
The course unit uses a numerical grading scale 1-5. In the numerical scale zero stands for a fail.
Person responsible:
Professor Kauko Leiviskä
Working life cooperation:
No
Other information:
-

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:
After the course the student is able to define the fundamentals and history of catalysis and he/she can explain the economical and environmental meaning of catalysis. The student is capable of specifying the design, selection and testing of catalysts and catalytic reactors and processes.
He/she is able to explain the most important industrial catalytic processes, the use of catalysts in environmental technology, catalyst research and the significance of an interdisciplinary approach in the preparation, development and use of catalysts. He/she recognizes the connection between catalysis and green chemistry and the role of catalysis in sustainable processes and energy production.
Contents:
Definition of catalysis and a catalyst, history of catalysis, economical, social and environmental meaning. Preparation of catalysts, principles, selection, design and testing of catalysts and catalytic reactors. Kinetics and mechanisms of catalytic reactions, catalyst deactivation. Industrially important catalysts, catalytic reactors and catalytic processes. Environmental catalysis. Catalysts in air pollution control and purification of waters. Catalysis and green chemistry. Catalysis for sustainability. Principles in the design of catalytic processes.
Mode of delivery:
Lectures including design exercises, face-to-face teaching.
Learning activities and teaching methods:
Lectures 40 h, exercises 10 h, homework 30 h, self-study 53 h.
Target group:
Master’s degree students of the Process and Environmental Engineering study programmes.
Prerequisites and co-requisites:
The courses 477011P Introduction to Process and Environmental Engineering I, 488010P Introduction to Process and Environmental Engineering II, and 780109P Basic Principles in Chemistry are recommended beforehand.
Recommended optional programme components:
-
Recommended or required reading:

Lecture handout; Richardson, J.T.: Principles of Catalyst Development. New York. 1989, 288 pp.; Janssen, F.J.J. G. & van Santen, R.A.: Environmental Catalysis. NIOK, Catalytic Science Series, Vol. 1. 1999. 369 pp.
*Additional literature:*Ertl, G., Knözinger, J. & Weitkamp, J.: Handbook of Heterogeneous Catalysis. Vol. 1-5. Weinheim. 1997, 657 p.; Thomas, J.M. & Thomas, W.J.: Principles and Practice of Heterogenous Catalysis. Weinheim 1997. 657 pp.; Somorjai, G.A.: Surface Chemistry and Catalysis. New York 1994, 667 pp.; van Santen, R.A., van Leuwen, P.W.N.M., Mouljin, J.A. & Averill, B.A.: Catalysis: An Integrated Approach, 2nd ed. Studies in Surface Science and Catalysis 123. Amsterdam 1999, Elsevier Sci. B.V. 582 pp.
Assessment methods and criteria:
Written examination and homework.
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:
Post-doctoral research fellow Tanja Kolli
Working life cooperation:
No
Other information:
-

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: Leiviskä, Kauko Johannes, 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, distillation columns 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:
Courses Material and Energy Balances, Heat Transfer, Mass Transfer and Control System Analysis 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:
Parts of the textbook used: Luyben, W.L.: Process Modeling, Simulation and Control for Chemical Engineers. McGraw Kogakusha Ltd., Tokyo 1973, 558 pp.
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:
Professor Kauko Leiviskä
Working life cooperation:
No
Other information:
-

488202S: Production and Use of Energy, 5 op

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:

488208A	Basics of production and use of energy	5.0 op
470057S	The Energy Economy of Industrial Establishments	3.5 op

ECTS Credits:
5 ECTS credits / 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 fourth (1 st Master's) autumn semester.
Learning outcomes:
The student is able to define different methods and techniques to generate electricity and heat. He/she is able to explain steam power plant operating principles and is able to compare operation of different kinds of steam power plants. The student can describe the environmental impacts of energy production and is able to compare the environmental impacts of different ways of producing energy. The student is able to identify functioning of the fossil based and renewable energy production systems. He/she is able to explain how the electricity markets work. The student is also able to explain the adequacy of energy reserves.
Contents:
Structure of energy production and consumption. Systems for electric transportation, storing and distribution. Distribution and adequacy of energy resources. Effects of environment contracts on the use of energy resources. Environmental comparison of different energy production methods and fuels. Energy markets. Development views of energy technology.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 40h, self-study 93 h.
Target group:
Master’s degree students of Process and Environmental Engineering study programmes.
Prerequisites and co-requisites:
The courses 477011P and 488010P Introduction to Process and Environmental Engineering I and II are recommended.
Recommended optional programme components:
-
Recommended or required reading:
Materials delivered via the Optima environment.

Assessment methods and criteria:
Written final exam.
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 lecturer Mika Huuhtanen
Working life cooperation:
No
Other information:
-

477125S: Recycling of bioproducts, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Process and Environmental Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Maria Salmela-Karhu

Opintokohteen kielet: English

Leikkaavuudet:

477128S	Circular Bioeconomy	5.0 op
477106S	Recycled Fiber Processes	3.0 op
477105S	Mechanical Processing of Biomasses	3.0 op

ECTS Credits:
5 ECTS / 133 h of work
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 waste streams from bioproduct industry. Student identifies collection and recovering systems, recovered material properties and their impact on processing, principles unit processes and processing with respect to final product requirement. A student should be able to identify the unit operations of required processing and explain their key operational principles and also the function of the most important chemicals. A student can also perceive the importance of life-cycle assessment and recyclability properties design in both R&D and production stages of bioproducts, including the significance of bioenergy production as a part of bioproduct recycling.
Contents:
Reuse, recycling and energy utilization of bioproduct and side streams of bioproduct industry in accordance with waste hierarchy. Analysis procedures to assess raw material utilization potential. Process concepts and unit processes in recycling and reusing of bioproducts including wood products, paper and board products, biocomposites and side streams. The utilization and final disposal of residuals from bioenergy production.
Mode of delivery:
Blended teaching
Learning activities and teaching methods:
The implementation methods of the course vary. Lectures and exercises 32 h, web learning 64 h, and self-study 37 h. A part of teaching can be replaced by group works or home works.
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 7: Recycled Fiber and Deinking. Lecture materials and other materials that will be announced at the lectures.
Assessment methods and criteria:
This course utilizes continuous assessment including lecture diarys, self tests during web learning and three intermediate exams. Alternatively, the course can also be completed by taking the end exam. 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:
Ari Ämmälä
Working life cooperation:
No
Other information:
-

477321S: Research Ethics, 3 op

Voimassaolo: - 31.07.2019

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Process and Environmental Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Keiski, Riitta Liisa, Ainassaari, Kaisu Maritta

Opintokohteen kielet: English

Leikkaavuudet:

477312S Science and Professional Ethics 5.0 op

ECTS Credits:
3 ECTS / 80 hours of work
Language of instruction:
English
Timing:
Implementation in spring semester during 3 rd period
Learning outcomes:
After the course the student is capable of explaining the meaning of research integrity and good scientific practice including honesty, conscientiousness and precision in research work. The student is able to plan, carry out and report his/her research work, and is aware of the rights and responsibilities of a researcher and his/her actions and respect towards other researchers. The student is able to recognise misconduct and fraud in scientific practices and has an awareness of how to handle misconduct.
Contents:
Ethically sound research, Scientific community and ethical problems in research work. Professional ethics of a researcher and an engineer. Research intergrity, good scientific practices and handling of misconduct and fraud in science. Regulations and rules. Definitions, Characteristic features of science, Research results and responsible persons in scientific work, Ethics and research ethics, Professional ethics of a researcher, Research integrity in Finland and globally, Instructions for preventing, handling and examining misconduct and fraud in scientific research, Good scientific practices and responsibility in performing research, Good practices in selecting the research problem, collecting the material, planning and performing the research, publishing, using and applying the results, Protection of a researcher under the law, Examples and statistics.
Mode of delivery:
Lectures and team work, face-to-face teaching
Learning activities and teaching methods:
Lectures 25 h, practical work 15 h, self-study 40 h
Target group:
Master’s degree students of the Process and Environmental Engineering study programmes.
Prerequisites and co-requisites:
-
Recommended optional programme components:
-
Recommended or required reading:

Clarkeburn, H. & Mustajoki, A. Tutkijan arkipäivän etiikkaa. Tampere 2007, Vastapaino.319 p., Responsible Conduct of Research and Procedures for Handling Allegations of Misconduct in Finland. Helsinki 2012, TENK, Finnish Advisory Board on Research Integrity, Martin, M.W. &Schinzinger, R. Ethics in Engineering, 4th Edition. New York, 2005, McGraw Hill Co. 339 p, Heikkerö, T. Tekniikka ja etiikka, Johdatus teoriaan ja käytäntöön, Espoo 2009, Tekniikan Aktateemisten Liitto, TEK, 160 s.
Additional literature: Hallamaa, J., Launis, V., Lötjönen, S. & Sorvali, I. Etiikkaa ihmistieteille. Tietolipas 211, Suomen Kirjallisuuden Seura, Helsinki 2006. 428 p., Pietilä, A.-M. & Länsimies-Antikainen, H. (Toim.) Etiikkaa monitieteisesti, Pohdintaa ja kysymyksiä. Kuopio 2008, Kuopio University Publications F. University Affairs 45.224 p.
Assessment methods and criteria:
Practical work assignments affect the course grade. Examination and a learning diary. 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:
Professor Riitta Keiski
Working life cooperation:
No
Other information:
-

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, Ainassaari, Kaisu Maritta

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 2 nd periods. 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:
Homework assignments affect the course grade. Examination. The course can be completed with two 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 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:
Laboratory manager Dr Esa Muurinen
Working life cooperation:
No
Other information:
-

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

Opintokohteen kielet: Finnish

Leikkaavuudet:

477503S	Simulation	3.0 op

ECTS Credits:
5 ECTS / 133 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:
Tuition is implemented mainly as face-to-face teaching
Learning activities and teaching methods:
The amount of guided teaching is 32 h, including lectures (16h), exercises (10h) and seminars (6h). 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:
Matlab programming skills are a benefit; see "Recommended optional programme components" below
Recommended optional programme components:
Programming in Matlab course reinforces abilities for the exercises and 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, case study, seminar and the final report. Final exam is an alternative for the final report.
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:
D.Sc. (Tech.) Esko Juuso
Working life cooperation:
No
Other information:
-

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 / 133 hours of work
Language of instruction:
English
Timing:
Period 2
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, intensive and interactive course. After an introductory presentation on the fundamentals of sustainable development; students will select a subject of their interest and prepare their own presentation on it with the help of expert mentors. The key issues to discuss include core concepts and tools such as SD goals and indicators, environmental justice, cultural diversity, international cooperation and action toward sustainable development and some additional subjects that can vary depending on recent advances or emerging trends each year, such as resource scarcity and conflicts, resilience of human and environmental systems; governance; business and globalization; and issues relating to technological change. As an exercise, a court case simulation is organized, in which every year a subject of current interest is "on trial".
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 4 h / student presentations (guided group work), discussions, opponency 26 h / court case simulation 5 h / home work 98 h.
Target group:

Master’s students of environmental engineering, especially of international master’s programmes such as the Master's Degree Programme in 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:
Lecture materials are recommended during the course by course lecturers and mentors. All materials are available through Optima.

Assessment methods and criteria:
Quality of student presentations, activity in discussions, performance as an opponent and in the court case simulation and learning diary. Compulsory requirements are presence on at least 80% of face-to-face lectures, participation in the group works, presenting own presentation and acting as an opponent to another presentation.

Grading:
The course evaluation will be based on participation and activity during the course. The course unit utilizes a numerical grading scale 1-5 (accepted grades) and zero stands for a fail.

Person responsible:
University teacher Virpi Väisänen

Working life cooperation:
No

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 /133 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 explain basic processes of water and wastewater treatment and can do the selection of needed process units and can dimensioning those.

Contents:
Characters of raw water, tap water and wastewater; used process units in water and waste water treatment; selection of process units; dimensioning treatment units and unit processes.

Mode of delivery:
Face-to-face teaching

Learning activities and teaching methods:
Lectures (20 h), exercises (40 h), self-study (75 h)

Target group:
Students in Master program of Environmental 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 I (477011P) and II (488010P)

Recommended optional programme components:
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Recommended or required reading:

Lecture hand-outs & Kemira, About water treatment. 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:

A) Active learning method: Composes of specialized lectures, individual and groups exercises. The student is assessed via completion of 2 exercises and a final exam (passed grade obligatory on exercises and exam). This method of course completion optimizes the learning outcomes. OR:

B) Book examination: 100% self-study option. Under especial circumstances (to be discussed with responsible teacher) when the student cannot take the active learning method the teacher will provide reading material (from one to several books) and the student will take an exam arranged within or outside the course schedule.

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:

Reseacher Elisangela Heiderscheidt

Working life cooperation:

No

Other information:

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