Opasraportti

Courses in English for Exchange Students, 2014-15: Process and Environmental Engineering (2014 - 2015)

This WebOodi Course Catalogue lists courses in Process engineering and Environmental Engineering taught in English for exchange students during academic year 2014-2015 at the Faculty of Technology, University of Oulu.

Course availability: Most of the listed courses are available for all exchange students in the **Faculty of Technology** (in the study fields of process engineering, environmental engineering, mechanical engineering, and industrial engineering and management). Exchange students from the **other Faculties** have to contact the Faculty Coordinator to ask about the possibility to participate to the listed courses.

When choosing the courses, please also check the previous knowledge requirements of the course (see the Course description: Prerequisites and co-requisites)!

For **more information**, please contact Faculty Coordinator (see contact info below).

All incoming exchange students must submit their Exchange Application through the University of Oulu SoleMOVE system , and you will also need to submit a course plan to that application. Further information on application process for incoming exchange students:
http://www.oulu.fi/english/studentexchange or at international.office@oulu.fi.

So, 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 (descriptions) of each course you wish to take (language of instruction, target group, course content, timing, preceding studies, additional information etc.).

After arrival, accepted exchange students are required to **register** to all courses (and later, to the 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 under the **Instruction tab**.

In the Catalogue the next types of courses and other instruction are described:

1. Courses where the language of instruction is English and which can be completed in English,
2. Courses where the actual language of instruction is Finnish, but which can be completed in English by an alternative method (e.g., the lecture materials, course books, exercises, and/or examinations are available in English).

Course schedules: Detailed information on teaching and schedule can be found under the **Instruction tab**. Our courses' schedules are based on so-called **periodical schedules** . Courses which are organised during periods 1-3 are given on the autumn term (September-December), and respectively the periods 4-6 refer to courses given during the spring term (January-May).

On the academic study year 2014-2015 these periods are scheduled as follows:

Autumn term:
Period 1. 1.9.-3.10. **2014**
Period 2. 6.10.-7.11.2014
Period 3. 10.11.-12.12.2014

Spring term
Period 4. 12.1.-13.2. **2015**
Period 5. 16.2.-27.3.2015
Period 6. 30.3.-8.5.2015

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 courses etc. in English in Process and Environmental Engineering 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
477206S: Advanced Process Design, 6 op
488204S: Air Pollution Control Engineering, 5 op
477508S: Automation in Metallurgical Industry, 5 op
477507S: Automation in Pulp and Paper Industry, 5 op
488302A: Basics of Biotechnology, 5 op
477103A: Bioproduct Technology, 3 op
488304S: Bioreactor Technology, 6 op
477204S: Chemical Engineering Thermodynamics, 5 op
477209S: Chemical Process Simulation, 5 op
477104S: Chemical Processing of Biomasses, 3 op
477602A: Control System Analysis, 4 op
477605S: Digital Control Theory, 4 op
488201A: Environmental Ecology, 5 op
488205S: Environmental Load of Process Industry, 4 op
477715S: Environmental and Social Responsibility in Mining, 5 op
477023A: Exercises of Process Engineering, 3 op
477041S: Experimental Design, 5 op
477606S: Fault Diagnosis and Process Performance Analysis, 2 op
477305S: Flow Dynamics, 5 op
477505S: Fuzzy-neuromethods in Process Automation, 4 op
488108S: Groundwater Engineering, 5 op
477302A: Heat Transfer, 3 op
488102A: Hydrological Processes, 5 op
488203S: Industrial Ecology, 5 op
488104A: Industrial and municipal waste management, 5 op
477021A: Laboratory Exercises of Process Engineering, 4 op
477021A-02: Laboratory Exercises of Process Engineering, Comminution and flotation, 1 op
477021A-05: Laboratory Exercises of Process Engineering, Control of a dosing appratus by using a programmable logic controller, 1 op
477021A-01: Laboratory Exercises of Process Engineering, Heat exchanger, 1 op
477021A-04: Laboratory Exercises of Process Engineering, Measurement and control of conductivity, 1 op
477021A-03: Laboratory Exercises of Process Engineering, Process design and examination of reaction kinetics, 1 op
477303A: Mass Transfer, 3 op

477201A: Material and Energy Balances, 5 op
477105S: Mechanical Processing of Biomasses, 3 op
477506S: Modelling and Control of Biotechnical Processes, 5 op
477301A: Momentum Transfer, 3 op
477308S: Multicomponent Mass Transfer, 5 op
477306S: Non-ideal Reactors, 5 op
477612S: Power Plant Control, 3 op
477108S: Printing Technology, 3 op
477501A: Process Control Engineering I, 5 op
477203A: Process Design, 5 op
477504S: Process Optimization, 4 op
477309S: Process and Environmental Catalysis, 5 op
488202S: Production and Use of Energy, 5 op
477106S: Recycling of Bioproducts, 3 op
477321S: Research Ethics, 3 op
477304A: Separation Processes, 5 op
477503S: Simulation, 3 op
488122S: Statistical Methods in Hydrology, 5 op
488105A: Water Supply Networks, 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: Satu Ojala, Keiski, Riitta Liisa
Opintokohteen kielet: English
Leikkaavuudet:

480360S Catalysts in Environmental Technology 5.0 op

ECTS Credits:
5 cr
Language of instruction:
English
Timing:
Implementation in spring semester during 5 th 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 is 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
Learning activities and teaching methods:
Lectures 30 h, seminar work 25 h.
Target group:
Master's degree students of the Department of Process and Environmental Engineering.
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 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:
University researcher Satu Ojala
Working life cooperation:
No
Other information:
-

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 cr
Language of instruction:
Finnish (English if necessary)
Timing:
Periods 4 and 5
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:
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Recommended or required reading:
Contact teaching the course and course web pages through the material distributed.
Assessment methods and criteria:
Exam and homeworks.
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:
-

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 cr
Language of instruction:
English
Timing:
The course is held in autumn and spring semesters during periods III and IV. It is recommended to complete the course in the 4 th or 5 th year.
Learning outcomes:
After completing this course, the student will be able to describe the most important techniques - both up- and downstream - in protein and metabolite production. Further, the student will be able to present main features of the biotechnology based on renewable raw materials.
Contents:
Microbial homologous and heterologous protein production. Physiological and process related items in the production of selected microbial metabolites. Principles and practices in metabolic engineering. Methods for process intensification. Unit operations in product recovery and purification. Specific features of biorefineries.
Mode of delivery:
Blended teaching.
Learning activities and teaching methods:
Lectures 30 h / exercises 6 h / homework 44 h / self-study 50 h.
Target group:
Master students of bioprocess engineering, environmental engineering students in M.Sc. Programme in Green Chemistry and Bioproduction, and process engineering students in Master's degree programme in Biomass, Technology and Management. Master students from process engineering and biochemistry with required prerequisites.

Prerequisites and co-requisites:
Prerequisites: The preceding courses by the Bioprocess Engineering Laboratory (especially 488301A Microbiology, 488302A Basics of biotechnology and 488304S Bioreactor technology) or respective knowledge.
Recommended optional programme components:
-
Recommended or required reading:
Will be announced at the lectures.
Assessment methods and criteria:
Lectures and final examination, exercises and the report. Grade will be composed of homework exercises, final examinations and 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:
Postdoctoral research fellow Sanna Taskila, university researcher Johanna Panula-Perälä
Working life cooperation:
No
Other information:
-

477206S: Advanced Process Design, 6 op

Voimassaolo: 01.08.2005 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Process and Environmental Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Ahola, Juha Lennart

Opintokohteen kielet: English

Leikkaavuudet:

477223S	Advanced Process Design	5.0 op
480350S	Advanced Process Design	5.0 op

ECTS Credits:
6 cr
Language of instruction:
English
Timing:
Periods 5-6.
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 15h and project group work 145h
Target group:
Master’s students in DPEE
Prerequisites and co-requisites:
Objectives of 477203A Process Design
Recommended optional programme components:

Part of Process Design Module
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:
Project work with oral and written reporting.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Scale 1-5
Person responsible:
University Lecturer Juha Ahola
Working life cooperation:
-
Other information:
-

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

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 cr
Language of instruction:
English
Timing:
Implementation in autumn semester during 3 rd 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 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. Measurement of emissions. Long - range transport and diffusion models. Emission control technologies, VOC emissions, SOx emissions, NOX emissions, heavy metals, POPs, HAPs, etc.
Mode of delivery:
Lectures.
Learning activities and teaching methods:
Lectures 30h and exercises 10h.
Target group:
Master’s degree students of the Department of Process and Environmental Engineering
Prerequisites and co-requisites:
The courses 477011P Introduction to Process Engineering, 488011P Introduction to Environmental Engineering 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
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:
University researcher Satu Ojala

Working life cooperation:
No

Other information:
-

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 cr

Language of instruction:
English

Timing:
Implementation in 5 th period.

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, rolling mill. Model solutions by special-purpose simulators. Also some special measurements are introduced

Mode of delivery:
Lectures

Learning activities and teaching methods:
Lectures during one period

Target group:
Master’s students in DPEE/Automation Technology

Prerequisites and co-requisites:
-

Recommended optional programme components:
-

Recommended or required reading:
Everyone does his/her material during the course.

Assessment methods and criteria:
Continuous evaluation: lectures, lecture diaries, test, 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:
-

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 cr
Language of instruction:
English
Timing:
Implementation in 3 rd period.
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 (fibers, chemicals, mechanical pulping, paper machines, factory-wide automation), process analysis, modelling, simulation. Application of intelligent methods in paper industry.
Mode of delivery:
Individual work; no lectures givens.
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 DPEE/Automation Technology
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.
Additional literature: -
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:
-

488302A: Basics of Biotechnology, 5 op

Voimassaolo: 01.08.2005 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Process and Environmental Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Johanna Panula-Perälä

Opintokohteen kielet: English

Leikkaavuudet:

488052A	Introduction to Bioproduct and Bioprocess engineering	5.0 op
480430A	Bioprocesses I	5.0 op

ECTS Credits:
5 cr
Language of instruction:
English
Timing:
The course is held in spring semester during periods IV and V. It is recommended to complete the course in the 3rd year.
Learning outcomes:
After completing this course, the student will be able to explain how the modern biotechnology can be applied in the food, pharma- and material industries, in the mining industry and environmental biotechnology, for example, in the production of alcoholic beverages and biofuels, antibiotics and other drugs, in metal manufacturing, and in biological degradation.
Contents:
Industrial biotechnology. Food biotechnology: Production of beer and alcoholic beverages; Biotechnology in dairy industry. Biotechnology in the mining and materials industries. Biorefineries. Biotechnology in forest industry. Biopolymer engineering. Environmental Biotechnology: Biodegradation; Bioremediation. Pharmaceutical biotechnology: Production of antibiotics and therapeutic proteins.
Mode of delivery:
Blended teaching.
Learning activities and teaching methods:
Lectures 32 h/ group work and seminar presentation 50 h/ self-study 50 h.
Target group:
Bachelor students in process engineering and environmental engineering, students in M.Sc. Programme in Green Chemistry and Bioproduction, and in Master's degree programme in Biomass, Technology and Management.
Prerequisites and co-requisites:
Courses 488301A Microbiology and 488308S Enzyme technology for students started 2011, or respective knowledge of microbiology and biocatalysis.
Recommended optional programme components:
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Recommended or required reading:
Will be announced at the lectures. Supplementary material: Aittomäki E ym.: BioProsessitekniikka. WSOY 2002. 951-26995-6; Salkinoja-Salonen M (toim.): Mikrobiologian perusteita. Helsingin yliopisto, 2002. 951-45-9502-5.
Assessment methods and criteria:
Lectures, intermediate exams and/or final exam, group work and seminar. Grade will be composed of lecture exams and/or final exam, group work and seminar.
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:
University teacher Johanna Panula-Perälä
Working life cooperation:
No

477103A: Bioproduct Technology, 3 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:

488052A	Introduction to Bioproduct and Bioprocess engineering	5.0 op
470308S	Pulp and Paper Technology	2.5 op

ECTS Credits:
3 cr
Language of instruction:
English
Timing:
Implementation in period 5.
Learning outcomes:
Upon completion of the course, a student should be able to identify key renewable natural resources and their sustainable and economical processing as well as end use.
Contents:
Lignocellulosic raw materials and their properties, value chains of biomass processing, recycling of biomaterials, bioenergy, and economical and environmental aspects.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures.
Target group:
Students interested in bioeconomy
Prerequisites and co-requisites:
-
Recommended optional programme components:
-
Recommended or required reading:
Book series: Fapet Oy. Papermaking Science and Technology, 20 books; Smook, G. A.: Handbook for Pulp and Paper Technologists. Vancouver 1992, 419 s. Lecture materials and other materials that will be announced at the lectures.
Assessment methods and criteria:
Exam.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
0-5
Person responsible:
Education coordinator
Working life cooperation:
No
Other information:
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488304S: Bioreactor Technology, 6 op

Voimassaolo: 01.08.2005 -
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Field of Process and Environmental Engineering
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: English
Leikkaavuudet:

488321S	Bioreactor technology	5.0 op

480431S Bioprocesses II 5.0 op

ECTS Credits:
6 cr
Language of instruction:
English
Timing:
The course is held in autumn semester during period I and II. It is recommended to complete the course in the 4 th 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 36 h / exercises 6 h / homework 50 h / self-study 68 h.
Target group:
Master students of bioprocess engineering and environmental engineering students in M.Sc. Programme in Green Chemistry and Bioproduction. Master students from process engineering and biochemistry with required prerequisites.
Prerequisites and co-requisites:
The bachelor level courses by the Environmental Engineering (especially 488301A Microbiology, 488302A Basics of biotechnology) 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 . Supplementary material: Enfors, S.-O., Häggström, L. . Bioprocess technology fundamentals and applications. Royal Institute of Technology. Stockholm 2011. ; Biotechnology (Vol 2): Fundamentals of biochemical engineering. . Toim. H.-J. Rehm and G. Reed, Weinheim, Wiley-VCH. 1991. Villadsen J., Nielsen J., Liden G. Bioreactor engineering principles. Springer Verlag, 2011.
Assessment methods and criteria:
Lectures, exercises, final exam, homework. Grade will be composed of final exam, exercises and homework
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:
University teacher Johanna Panula-Perälä, postdoctoral research fellow Sanna Taskila
Working life cooperation:
No
Other information:
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477204S: Chemical Engineering Thermodynamics, 5 op

Voimassaolo: 01.08.2005 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Process and Environmental Engineering

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
5 cr
Language of instruction:
Finnish
Timing:
Period 1.
Learning outcomes:
By completing the course the student understands classical thermodynamics from a chemical engineering viewpoint. Especially she/he can explain the pVT behaviour of pure substances and understands the thermodynamic properties of mixtures. The student can classify the thermodynamic models describing, for example, liquid mixtures or electrolytes. The student can select appropriate models for gas, vapour and liquid phases. In addition, the student can solve process models, phase equilibrium and chemical reaction equilibrium problems, and more generally, is able to evaluate chemical processes using thermodynamic analysis tools.
Contents:
Mass and energy balances, pVT behaviour of pure substances, thermodynamic properties of fluids, thermodynamics of electrolytes, chemical reaction equilibrium, vapour/liquid equilibrium, calculation of thermodynamical state functions, thermodynamic analysis of processes.
Mode of delivery:
-
Learning activities and teaching methods:
Lectures 40h and self-study 90h
Target group:
-
Prerequisites and co-requisites:
Thermodynamic equilibria
Recommended optional programme components:
Part of Process Design Module
Recommended or required reading:
Lecture handout. Material given during the lectures. Additional literature, Smith, J.M. & Van Ness, H.C. Introduction to Chemical Engineering Thermodynamics. McGraw-Hill, 1987.
Assessment methods and criteria:
Combination of examinations and exercises
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Scale 1-5
Person responsible:
Professor Juha Tanskanen
Working life cooperation:
-
Other information:
-

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 cr
Language of instruction:
English
Timing:
Periods 2-3.

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 architecture of a process simulator. Thermodynamic property models and databanks. Degrees of freedom analysis. Steady-state simulation. Sequential modular, and equation-oriented approach in simulation. Numerical solving methods. Heuristics for chemical process simulation.
Mode of delivery:
Lectures, introductory examples and group exercises with process simulation software.
Learning activities and teaching methods:
Lectures 16h and self-study 114h
Target group:
Master's students in Process Design and Chemical Engineering orientations
Prerequisites and co-requisites:
Prerequisite: 477204S Chemical Engineering Thermodynamics or equivalent knowledge.
Recommended optional programme components:
-
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 an individual exam.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Scale 1-5
Person responsible:
University Teacher Jani Kangas
Working life cooperation:
-
Other information:
-

477104S: Chemical Processing of Biomasses, 3 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Process and Environmental Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Ari Ämmälä

Opintokohteen kielet: Finnish

Leikkaavuudet:

477123S	Chemical processing of biomasses	5.0 op
470111S	Woodpulp Manufacture	2.5 op

ECTS Credits:
3 cr
Language of instruction:
Finnish
Timing:
Implementation in period 1 every other year.
Learning outcomes:
Upon completion of the course, a student should be able to identify unit operations of chemical pulping process and can explain their operational principles. The student is able to evaluate the effect of raw material properties and the importance of different unit operations on quality of the end product. In addition, the student is able to

identify the cooking and bleaching chemicals used in chemical pulping and can describe the most important chemical reactions occurring in the process. In addition, the student is able to identify chemicals and products of wood based biorefinery.
Contents:
Raw materials, fundamentals of chemical pulping, circulation of chemicals in kraft pulping, bleaching of pulp. Wood- and nonwood-based biorefining.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures.
Target group:
Students interested in bioeconomy
Prerequisites and co-requisites:
477103A Bioproduct technology is recommended
Recommended or required reading:
Book series: Fapet Oy. Papermaking Science and Technology, book 6 (A ja B). Chemical pulping. A 693 s. ja B 497 s. Lecture materials and other materials that will be announced at the lectures.
Assessment methods and criteria:
Exam. Literature exam possible for foreign students.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
0-5
Person responsible:
Education coordinator
Working life cooperation:
No
Other information:
Literature exam possible for foreign students.

477602A: Control System Analysis, 4 op

Voimassaolo: 01.08.2005 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Process and Environmental Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Seppo Honkanen

Opintokohteen kielet: Finnish

Leikkaavuudet:

477621A	Control System Analysis	5.0 op
470460A	Controls and Systems Engineering Fundamentals	5.0 op

ECTS Credits:
4 cr
Language of instruction:
Finnish
Timing:
Periods 2 and 3
Learning outcomes:
After completing the course the student can describe the process dynamics of 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 behaviour of processes in time and frequency range specifications through.
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 course 4770xxP Introduction to automation engineering recommended beforehand
Recommended optional programme components:
-
Recommended or required reading:
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 homework's
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 1.5 or fail
Person responsible:
Lecturer Jukka Hiltunen and University teacher Seppo Honkanen
Working life cooperation:
No
Other information:
-

477605S: Digital Control Theory, 4 op

Voimassaolo: 01.08.2005 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Process and Environmental Engineering

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

477624S	Control System Methods	5.0 op
470453S	Digital Control Theory	5.0 op

ECTS Credits:
4 cr
Language of instruction:
Finnish
Timing:
Periods 2 and 3
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. Sampled data systems: sampling, Z transformation of signals. 2. Discrete-time modelling: difference equation, shift operator, pulse transfer function, polynomial and state-space description. 3. Analysis of discrete-time systems: z-plane, stability. 4. 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 4770xxP Introduction to process and environmental engineering II, 477602A Control system analysis and 477603A Control system design recommended beforehand
Recommended optional programme components:
-

Recommended or required reading:
Lecturer's note. 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:
The course concludes in a written exam; to request an exam in English, contact the lecturer via email beforehand. Read more about assessment criteria at the University of Oulu webpage.
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 cr
Language of instruction:
English
Timing:
Implementation in spring semester during 4 th and 5 th period.
Learning outcomes:
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 learning.
Learning activities and teaching methods:
E-learning in the Optima learning environment.
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:
-

Recommended or required reading:
Chiras D.: Environmental Science: Creating a Sustainable Future. New York, Jones and Bartlett Publishers, 2001.
Assessment methods and criteria:
Exercises and exam.
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:
University researcher Satu Ojala
Working life cooperation:
No
Other information:
-

488205S: Environmental Load of Process Industry, 4 op

Voimassaolo: 01.08.2005 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Process and Environmental Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Niina Koivikko

Opintokohteen kielet: English

Leikkaavuudet:

ay488215S	Industry and Environment (OPEN UNI)	5.0 op
488215S	Industry and Environment	5.0 op
488221S	Environmental Load of Industry	5.0 op
480314S	Control of Environmental Load from Processes of Pulp and Paper Industry	2.5 op
480315S	Control of Environmental Load from Processes of Metallurgical Industry	2.5 op

ECTS Credits:
4 cr
Language of instruction:
English
Timing:
Implementation in spring semester during 6 th 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 able to apply 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:
Lectures.
Learning activities and teaching methods:
Lectures 30 h.
Target group:
Master’s degree students of the Department of Process and Environmental Engineering
Prerequisites and co-requisites:
The courses 477011P Introduction to Process Engineering, 488011P Introduction to Environmental Engineering, 488204S Air Pollution Control Engineering and 488110S Water and Wastewater Treatment recommended beforehand.
Recommended optional programme components:
-

Recommended or required reading:
Material represented in lectures and in the Optima environment.
Assessment methods and criteria:
Written final exam
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:
University researcher Satu Ojala
Working life cooperation:
No
Other information:
-

477715S: Environmental and Social Responsibility in Mining, 5 op

Voimassaolo: 01.08.2013 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Process and Environmental Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Jaakko Rämö

Opintokohteen kielet: English

ECTS Credits:
5 cr
Language of instruction:
English
Timing:
In periods 1-3. It is recommendable the student to take this course on the first year, or on the second year autumn term, of the Master's degree phase of his/her studies, i.e. the fourth year / fifth year autumn of all.
Learning outcomes:
After completion of this course the student is able to develop, apply and assess the targets, practices and methods of environmentally and socially responsible mining in practice.
Mode of delivery:
Implemented as distance learning.
Learning activities and teaching methods:
Lectures and exercises by distance learning & learning diaries.
Target group:
The students of the Mineral Processing study option in the study programmes Process Engineering or Environmental Engineering, etc. and the students of Luleå University of Technology (LTU) within the Nordic Mining School (NMS) agreement between LTU and the University of Oulu.
Prerequisites and co-requisites:
The Bachelor level studies of the process or environmental engineering study programmes or respective knowledge, and the preceding Master level studies or respective knowledge.
Recommended optional programme components:
The other courses of the Master's phase curriculum.
Recommended or required reading:
Lectures + articles delivered during lectures
Assessment methods and criteria:
Participation to the lectures & learning diary.
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:
Prof. Rauno Sairinen (University of Eastern Finland), Nordic Mining School Coordinator Jaakko Rämö (Thule Institute, University of Oulu).
Working life cooperation:
No
Other information:

This course is organized within the Nordic Mining School (NMS) agreement between Luleå University of Technology, Sweden and the University of Oulu.

477023A: Exercises of Process Engineering, 3 op

Voimassaolo: 01.01.2012 -
Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Field of Process and Environmental Engineering
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: English

ECTS Credits:
3 cr
Language of instruction:
English
Timing:
Periods 1-6
Learning outcomes:
The student identifies the main mechanical unit processes and is able to explain their operation principle. The student demonstrates in the laboratory exercises that he/she can use a programmable logic and is able to tune the PID controller experimental facilities.
Contents:
The student will be do three laboratory exercises.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
The laboratory work will be done separately for the time allocated for them and producing a report.
Target group:
Exchange students
Prerequisites and co-requisites:
Prerequisites of the following courses: 477011P Introduction to process and environmental engineering I and 477012P Introduction to automation engineering
Recommended optional programme components:
-
Recommended or required reading:
To be announced later.
Assessment methods and criteria:
Laboratory work and the report.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 1-5 or fail
Person responsible:
University teachers
Working life cooperation:
No
Other information:
The objective is that student will familiarize with occupational practice of the field and experimental research and also learn how to report results.

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 cr
Language of instruction:
English
Timing:
Implementation in 4 th period.
Learning outcomes:
After this course the student knows the main 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 supporting the learning of measurements uncertainty assessment preparation; Experimental design software (Modde, Minilab, Matlab tools); Experimental design preparation and execution in laboratory scale research. Test methods and variable significance, reliability of experimental data; Problems in laboratory, pilot and full scale experiments, problems in modelling and in simulation.
Mode of delivery:
Lectures and practical work.
Learning activities and teaching methods:
Contact lectures
Target group:
Master's students in DPEE
Prerequisites and co-requisites:
No prerequisites
Recommended optional programme components:
-
Recommended or required reading:
Material given in the lectures.
Assessment methods and criteria:
Assessment during the course, by continuous evaluation with lecture exams, and 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:
-

477606S: Fault Diagnosis and Process Performance Analysis, 2 op

Voimassaolo: 01.08.2005 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Process and Environmental Engineering

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

477623S	Process Information Systems	10.0 op
477610S	Process Information Systems	5.0 op

ECTS Credits:
2 cr
Language of instruction:
Finnish
Timing:
Periods 4 and 5

Learning outcomes:
The period of study completed, the student can implement processes running and maintenance of performance-enhancing systems.
Contents:
Model- and data-based diagnostic methods, measurement validation, key figure calculation, process performance assessment and follow-up, application examples.
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 477601A Process automation systems, 477602A Control system analysis and 477603A Control system design recommended beforehand
Recommended optional programme components:
-
Recommended or required reading:
Lecture handout. Additional literature will be announced later.
Assessment methods and criteria:
Examination or project works.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 1.5 or fail
Person responsible:
Lecturer Jukka Hiltunen and Ph.D. student Harri Aaltonen
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 cr
Language of instruction:
Finnish, can be completed in English as a book examination.
Timing:
Implementation in autumn semester during 2 nd period.
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:
Lectures and compulsory exercise done in small groups.

Learning activities and teaching methods:
Lectures 25 h, and exercise 15 h. For foreign students written examination based on given literature and a simulation exercise.

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

Prerequisites and co-requisites:
Courses 477301A Momentum Transfer, 031019P Matrix Algebra and 031022P Numerical Methods 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:
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 exercise.
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:
Laboratory manager Esa Muurinen

Working life cooperation:
No

Other information:
-

477505S: Fuzzy-neuromethods in Process Automation, 4 op

Voimassaolo: 01.08.2005 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Process and Environmental Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Esko Juuso

Opintokohteen kielet: Finnish

Leikkaavuudet:

477525S	Computational intelligence in automation	5.0 op
470438S	Fuzzy Sets and Neural Networks in Process Automation	3.5 op

ECTS Credits:
4 cr

Language of instruction:
Finnish and English

Timing:
Implementation in 5 th period. Recommended for fourth year students (M.Sc.).

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 genetic algorithms. 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 optimization. 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-fuzzymethods, 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 38 hrs, including lectures, demonstrations, exercises and seminars. Totally 68,7 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:

-

Recommended optional programme components:

Simulation course and Programming in Matlab course reinforce abilities for the exercises and the case study.

Recommended or required reading:

Lecture notes and exercise materials.

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 assessment criteria at the University of Oulu webpage.

Grading:

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

Person responsible:

University teacher Esko Juuso

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 cr

Language of instruction:

English

Timing:

The course unit is held in the autumn semester, during periods 1-2
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 orientation 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 hand-outs, Physical and Chemical Hydrogeology (Domenico PA, Schwartz FW, 2nd edition, 1998, ISBN 0-471-59762-7). Maanalaiset vedet - pohjavesigeologian 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:
Professor Björn Klöve and Researcher Pekka Rossi
Working life cooperation:
No
Other information:
The course is arranged in alternate years (odd autumn semesters).

477302A: Heat Transfer, 3 op

Voimassaolo: 01.08.2005 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Process and Environmental Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Tuomaala, Eero Juhani

Opintokohteen kielet: Finnish

Leikkaavuudet:

477322A	Heat and Mass Transfer	5.0 op
470620A	Heat Transfer	3.0 op

ECTS Credits:
3 cr
Language of instruction:
Finnish, can be completed in English as a book examination.
Timing:
Implementation in spring semester during 5 th period.
Learning outcomes:
After passing the course the student knows what happens when heat is transferred by conduction, convection and radiation. After the course 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. 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 is able to divide the costs of the used energy in right proportion based on the processing stage.

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.

Mode of delivery:

Lectures including exercises.

Learning activities and teaching methods:

Lectures 20 h, exercises 15 h and homework 10 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:

Course 477301A Momentum Transfer is 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:

Bird, R, B., Stewart, W.E. & Lightfoot, E.N., Transport Phenomena, John Wiley & Sons, 1976, 780 p.; Linnhoff, B. et al.: A User Guide on Process Integration for the Efficient Use of Energy, The Institution of Chemical Engineers, 1987, 247 p.

Additional literature: Jokilaakso, A., Virtaustekniikan, lämmönsiirron ja aineensiirron perusteet, 496, Otakustantamo, 1987, 194 p. Coulson, J.F. et al., Chemical engineering vol.1, 4th ed., Pergamon Press, 1990. 708 p. Peters, M.S. &Timmerhaus, K.D., Plant design and economics for chemical engineers, 4th ed., McGraw-Hill, 1991, 910 p. Sussman, M.V., Availability (exergy) analysis, Mulliken House, 1985, 94 p.

Assessment methods and criteria:

Examination or continuous evaluation.

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:

University teacher Eero Tuomaala

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 cr

Language of instruction:
Finnish, self-study package in English
Timing:
The course unit is held in the spring semester, during periods 4-5 but the self-study package in English cab be done in periods 1-6.
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.
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 self-study package course, 4 tutor sessions are arranged during the 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, 3 rd 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%).
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:
University Lecturer A-K 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

Opintokohteen kielet: English

Leikkaavuudet:

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

ECTS Credits:
5 cr
Language of instruction:
English
Timing:
Implementation in autumn semester during 2 th period.
Learning outcomes:

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:
Lectures.

Learning activities and teaching methods:
Lectures 30 h, compulsory exercise work.

Target group:
Master's degree students of the Department 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:
Assignments and written final exam
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:
University researcher Satu Ojala

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 cr

Language of instruction:
English

Timing:
The course unit is held in the spring semester, during periods 5-6

Learning outcomes:
The student will acquire a wilder 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 hierarch, 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:
Learning methods: A) Active learning method: Lectures (24 h), group work (45 h), self-study for examination (55,5 h) and field visits (8 h) or alternatively B) Group work (45 h), self-study for examination (87,5 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:
The students' performance during the course is assessed by successful completion of stages A and B as follow: A) Completion of the course work which consists of group exercises 1 and 2 each carrying 30% weight in the course final grade; B) Course examination carrying 40% weight in the course final grade (Note that a passing grade (1-5) for the course examination is required for the completion of the course).
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 Heiderschedt
Working life cooperation:
No
Other information:
-

477021A: Laboratory Exercises of Process Engineering, 4 op

Voimassaolo: 01.08.2005 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Process and Environmental Engineering

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

480320A	Laboratory Exercises of Process Engineering	3.5 op
470223A	Laboratory Experiments of Chemical Process Engineering	3.5 op
470325A	Laboratory Exercises of Mass and Heattransfer	3.0 op
470440A	Laboratory Exercises in Systems Engineering	2.5 op
470442A	Process Control Engineering Laboratory Exercises	3.0 op

ECTS Credits:
4 cr
Language of instruction:
Finnish
Timing:
Periods 1-6
Learning outcomes:
The student knows how to calculate the overall heat-transfer coefficient for co- and countercurrent heat exchangers with the aid of temperatures and flows. The student identifies the main mechanical unit processes and is able to explain their operation principle. Student knows how to implement tools to estimate reaction kinetic

parameters based on experimental batch reactor data. The student is familiar with the stages of reactor design in early phases of process design. The student demonstrates in the laboratory exercises that he/she can use a programmable logic and is able to tune the PID controller experimental facilities.
Contents:
The student chooses four laboratory exercises from the offered ones related to process and automation engineering.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
The laboratory work will be done separately for the time allocated for them and producing a report.
Target group:
B.Sc. students in process and environmental engineering
Prerequisites and co-requisites:
477011P Introduction to process and environmental engineering I, 4770xxP Introduction to process and environmental engineering II, 477302A Heat transfer and 477202A Reactor analysis
Recommended optional programme components:
The course 477602A Control System Analysis should be completed simultaneously
Recommended or required reading:
To be announced later.
Assessment methods and criteria:
Laboratory work and the report.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 1-5 or fail
Person responsible:
University teachers
Working life cooperation:
No
Other information:
-

477021A-02: Laboratory Exercises of Process Engineering, Comminution and flotation, 1 op

Voimassaolo: 01.08.2005 -

Opiskelumuoto: Intermediate Studies

Laji: Partial credit

Vastuuyksikkö: Field of Process and Environmental Engineering

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

477021A-05: Laboratory Exercises of Process Engineering, Control of a dosing appratus by using a programmable logic controller, 1 op

Voimassaolo: 01.08.2005 -

Opiskelumuoto: Intermediate Studies

Laji: Partial credit

Vastuuyksikkö: Field of Process and Environmental Engineering

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

477021A-01: Laboratory Exercises of Process Engineering, Heat exchanger, 1 op

Voimassaolo: 01.08.2005 -
Opiskelumuoto: Intermediate Studies
Laji: Partial credit
Vastuuyksikkö: Field of Process and Environmental Engineering
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

477021A-04: Laboratory Exercises of Process Engineering, Measurement and control of conductivity, 1 op

Voimassaolo: 01.08.2005 -
Opiskelumuoto: Intermediate Studies
Laji: Partial credit
Vastuuyksikkö: Field of Process and Environmental Engineering
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

477021A-03: Laboratory Exercises of Process Engineering, Process design and examination of reaction kinetics, 1 op

Voimassaolo: 01.08.2005 -
Opiskelumuoto: Intermediate Studies
Laji: Partial credit
Vastuuyksikkö: Field of Process and Environmental Engineering
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

477303A: Mass Transfer, 3 op

Voimassaolo: 01.08.2005 -
Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Field of Process and Environmental Engineering
Arvostelu: 1 - 5, pass, fail
Opettajat: Ainassaari, Kaisu Maritta, Tuomaala, Eero Juhani
Opintokohteen kielet: Finnish
Leikkaavuudet:

477322A	Heat and Mass Transfer	5.0 op
470621A	Mass Transfer	3.0 op

ECTS Credits:
3 cr
Language of instruction:
Finnish, can be completed in English as a book examination.
Timing:
Implementation in autumn semester during 1 st period.

Learning outcomes:
After the course the 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 theories of Fick and Maxwell-Stefan and to compare the models to each other. 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:
Diffusion. The laws of diffusion by Fick and Maxwell-Stefan.Mass transfer in simple systems. Differential mass balances. Models of mass transfer in turbulent systems. Interphase mass transfer. Absorption.Drying of solid.
Mode of delivery:
Lectures including exercises.
Learning activities and teaching methods:
Lectures 20 h, exercises 15 h and homework 10 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:
Courses 477301A Momentum Transfer and 477302A Heat 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:
Bird, R,B., Stewart, W.E. & Lightfoot, E.N.: Transport Phenomena, John Wiley & Sons, 1976, 780 p.; King, C.J.: Separation Processes, McGraw-Hill, 1980, 850 p.; Wesselingh J.A. & Krishna R.: Mass Transfer, Ellis Horwood, 1990, 243 p.
Additional literature: Jokilaakso, A., Virtaustekniikan, lämmönsiirron ja aineensiirron perusteet, 496, Otakustantamo, 1987, 194 p.; Coulson, J.F. et. al.: Chemical Engineering vol.1, 4th ed., Pergamon Press, 1990. 708 p.; McCabe, W.L. et al.: Unit Operations of Chemical Engineering, 5th ed., McGraw-Hill, 1993, 1130 p.
Assessment methods and criteria:
Examination or continuous evaluation.
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:
University teacher Kaisu Ainassaari
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 cr
Language of instruction:
Finnish.

Timing:
Periods 1-2.
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 exercises.
Learning activities and teaching methods:
Lectures 40h and Self-study 90h
Target group:
Bachelor students in DPEE
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:
Continual assessment based on exams and group exercises.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Scale 1-5
Person responsible:
University Teacher Ilkka Malinen
Working life cooperation:
No
Other information:
-

477105S: Mechanical Processing of Biomasses, 3 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Process and Environmental Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Ari Ämmälä

Opintokohteen kielet: Finnish

Leikkaavuudet:

477124S	Mechanical processing of biomasses	5.0 op
470310S	Mechanical Pulping	2.5 op

ECTS Credits:
3 cr
Language of instruction:
Finnish
Timing:
Implementation in period 2 every other year.
Learning outcomes:
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 quality of the end product. In addition, the student can compare fibre properties of different mechanical and chemi-mechanical pulps and can explain their effects on the quality of the end product.
Contents:
Processing of wood, mechanical fibres, wood powders: raw material properties, mechanical defibering, screening, bleaching, biomass micronisation, production of engineered wood, wood-plastic composites and pellets. Products properties.

Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures.
Target group:
Students interested in bioeconomy
Prerequisites and co-requisites:
477103A Bioproduct technology is recommended
Recommended optional programme components:
-
Recommended or required reading:
Book series: Fapet Oy. Papermaking Science and Technology, book 5. Mechanical Pulping. 427 s.; Smook, G. A.: Handbook for Pulp and paper Technologists. Vancouver 1992, 419 s. Lecture materials and other materials that will be announced at the lectures.
Assessment methods and criteria:
Exam. Literature exam possible for foreign students.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
0-5
Person responsible:
Education coordinator
Working life cooperation:
No
Other information:
Literature exam possible for foreign students.

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 cr
Language of instruction:
English
Timing:
Implementation in 1 st period.
Learning outcomes:
After the course, the student can model kinetics and dynamics of biotechnical 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 modeling approaches with examples. Control
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 DPEE/Automation Technology
Prerequisites and co-requisites:

Course Process Control Engineering I recommended beforehand
Recommended optional programme components:
-
Recommended or required reading:
Lecture material.
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)29-48; Rani, K.Y. & Rao, V.S.R.: Control of Fermenters - a Review. Bioprocess Engineering 21(1999)77-88.
Assessment methods and criteria:
Grade given is based on home tests and exercise report; ratio is 4/1. Final examination is also possible. Then the accepted exercise corresponds to one test example.
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, M.Sc(eng) Aki Sorsa
Working life cooperation:
No.
Other information:
-

477301A: Momentum Transfer, 3 op

Voimassaolo: 01.08.2005 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Process and Environmental Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Ainassaari, Kaisu Maritta, Tuomaala, Eero Juhani

Opintokohteen kielet: Finnish

Leikkaavuudet:

477052A	Fluid Mechanics	5.0 op
470619A	Fluid Mechanics	3.0 op

ECTS Credits:
3 cr
Language of instruction:
Finnish, can be completed in English as a book examination.
Timing:
Implementation in spring semester during 4 th period.
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. Basic principles of computational fluid dynamics (CFD).
Mode of delivery:
Lectures including exercises.
Learning activities and teaching methods:
Lectures 20 h, exercises 15 h and homework 10 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:
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:
Bird, R.B., Stewart, W.E. & Lightfoot, E.N., Transport phenomena, John Wiley & Sons, 1976, 780 p.
Additional literature: Jokilaakso, A., Virtaustekniikan, lämmönsiirron ja aineensiirron perusteet, 496, Otakustantamo, 1987, 194 p. Coulson, J.F. et al., Chemical engineering vol.1, 4th ed., Pergamon Press, 1990. 708 p. Shaw, C.T., Using computational fluid dynamics, Prentice Hall, 1992, 251 p.
Assessment methods and criteria:
Examination or continuous evaluation.
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:
University teacher Eero Tuomaala
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 cr
Language of instruction:
Finnish, can be completed in English as a book examination.
Timing:
Implementation in spring semester during 5 th period.
Learning outcomes:
Upon completing the required coursework the student is able to formulate the 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. The student 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. He/she is also able 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 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:
Lectures including exercises.
Learning activities and teaching methods:

Lectures 30 h, exercises 8 h and simulation exercise 15 h. For foreign students 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, 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 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:
Laboratory manager 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 cr
Language of instruction:
English
Timing:
Implementation in autumn semester during 3 rd period.
Learning outcomes:
Objective: By means of the residence time distribution theory, students adopt a way of thinking in modeling which is based on the concept of probability.
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.
Learning activities and teaching methods:

Lectures 35 h, exercises 12 h, homework 12 h
Target group:
Master's degree students of the Department of Process and Environmental Engineering.
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 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 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.

477612S: Power Plant Control, 3 op

Voimassaolo: 01.01.2010 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Process and Environmental Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Jenö Kovács

Opintokohteen kielet: English

Leikkaavuudet:

477625S	Power Plant Automation	5.0 op

ECTS Credits:
3 cr
Language of instruction:
English
Timing:
Period 6
Learning outcomes:
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 will able to explain the behaviour of control of sub processes.
Contents:
Detailed description of different power plant types and their operation. Advances in power plants technology – once-through boilers. The control principles and the main control loops. Comparison of different control solutions. The interaction between different parts of the power plants. Coordinated control. Control of sub processes. Advanced control solutions.
Mode of delivery:
face-to-face teaching
Learning activities and teaching methods:
Lectures, exercises and simulation exercises.
Target group:

M.Sc. students of process and environmental engineering.
Prerequisites and co-requisites:
Requirement: completing the course of 477611S Power Plant Automation or equivalent knowledge.
Recommended optional programme components:
-
Recommended or required reading:
Lecture hand-out and material will be provided at the beginning of the course.
Assessment methods and criteria:
Examination.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 1.5 or fail
Person responsible:
Docent Jenö Kovács
Working life cooperation:
No
Other information:
-

477108S: Printing Technology, 3 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Process and Environmental Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Ari Ämmälä

Opintokohteen kielet: English

ECTS Credits:
3 cr
Language of instruction:
English
Timing:
Course available around the year as a web based self learning course.
Learning outcomes:
Upon completion of the course, a student should be able to identify those paper properties that affect printing of paper and can evaluate their importance in result of printing. The student can explain different printing methods and processes. In addition, the student identifies printing inks and can explain their most important properties.
Contents:
Development of printing, image formation and assessment methods, mechanical and electronic (digital) printing, demands of the printing methods for the paper, printing ink, their properties and basics of print media recycling.
Mode of delivery:
Webcourse
Learning activities and teaching methods:
Weblearning and self tests, final exam.
Target group:
Students interested in bioeconomy
Prerequisites and co-requisites:
-
Recommended optional programme components:
-
Recommended or required reading:
Handbook of Print Media (Kipphan 2000); Papermaking Science and Technology, book 13: Print media - principles, processes and quality. Fapet Oy.
Assessment methods and criteria:
Exam.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
0-5
Person responsible:
Education coordinator

Working life cooperation:
No
Other information:
Please contact the course teacher when you plan on taking this course.

477501A: Process Control Engineering I, 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

Opintokohteen kielet: Finnish

Leikkaavuudet:

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

ECTS Credits:
5 cr
Language of instruction:
Finnish/English
Timing:
Implementation in 3 rd period.
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 larger processes.

Learning activities and teaching methods:
Lectures during one period
Target group:
Bachelor's students in DPEE
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.; Yang, W.J., Masubuchi, M.: Dynamic Process and System Control. Gorden and Breach Science Publishers, New York 1970. 448 s.
Assessment methods and criteria:
Home work and written/oral test.
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:
-

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 cr
Language of instruction:
English
Timing:
Periods 4-5.
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 group exercises.
Learning activities and teaching methods:
Lectures 30h, group work 50h and self-study 50h
Target group:
Bachelor students in DPEE
Prerequisites and co-requisites:
Objectives of 477202A Reactor analysis, 477304A Separation processes and 477012 Introduction to Automation Engineering
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 group exercises.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Scale 1-5
Person responsible:
University Teacher Jani Kangas
Working life cooperation:
-
Other information:
-

477504S: Process Optimization, 4 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: Finnish

Leikkaavuudet:

477524S	Process Optimization	5.0 op
477524S	Process Optimization	5.0 op
470434S	Process Optimization	5.0 op

ECTS Credits:
4 cr
Language of instruction:
Finnish; English possible, but requires 2 week advance notice
Timing:
Spring semester, 4th period. Recommended for first year M.Sc. students.
Learning outcomes:
Student can use and apply standard unconstrained and constrained optimization methods. Student can define and identify an optimization problem and solve it using Matlab. Student is able to summarize the role of optimization in process engineering.
Contents:
Basic concepts of optimization, Optimization of uncontstrained functions, Nonlinear least squares problems, Linear programming, Nonlinear programming, Applications in process engineering, Matlab (TM) and optimization
Mode of delivery:
Tuition is implemented as face-to-face teaching and blended teaching (web-based teaching + face-to-face teaching).
Learning activities and teaching methods:
The amount of guided teaching is 40 hrs and for self-study there are 66.7 hrs allocated. Contact teaching includes, depending on situation, lectures, group work and tutored group work. During self-study time student does independent work or group work.
Target group:
M.Sc. students of process and environmental engineering and M.Sc. students interested in process optimization.
Prerequisites and co-requisites:
No prerequisites but basic understanding on numerical methods and process modeling are useful.
Recommended optional programme components:
See prerequisites
Recommended or required reading:
Edgar, T.F., Himmelblau, D.M. & Lasdon, L.S. (2001) Optimization of chemical processes. McGraw-Hill. ISBN 0-07-118977-7.;
Ray, W.H. & Szekeley, J. (1973) Process Optimization. John Wiley & Sons.
Assessment methods and criteria:
This course uses continuous assessment. There are 15 exercises, 5 home work and 3 learning diaries. Deadlines are observed. The assessment of the course is based on the learning outcomes of the course. Terminal exam possible.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
The course unit uses a numerical grading scale 1-5. In the numerical scale zero stands for a fail.
Person responsible:
D.Sc. Juha Jaako, lecturer
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

Opintokohteen kielet: English

Leikkaavuudet:

470226S Catalytic Processes 5.0 op

ECTS Credits:
5 cr
Language of instruction:
English
Timing:
Implementation in autumn semester, during 2 nd period.
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 recognises 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 and soil.Catalysis and green chemistry.Catalysis for sustainability. Principles in the design of catalytic processes.
Mode of delivery:
Lectures including design exercises.
Learning activities and teaching methods:
Lectures 30 h, exercises 10 h and homework 30 h.
Target group:
Master's degree students of the Department of Process and Environmental Engineering.
Prerequisites and co-requisites:
The courses 477011P Introduction to Process and Environmental Engineering I, 488011P Introduction to Environmental Engineering, 780109P Basic Principles in Chemistry and 477306S Non-ideal reactor 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 assessment criteria at the University of Oulu webpage.
Grading:
The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.
Person responsible:
Post-doctoral research fellow Tanja Kolli
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 cr
Language of instruction:
English
Timing:
Implementation in autumn semester during 1 st period.
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:
Lectures
Learning activities and teaching methods:
Lectures 40h.
Target group:
Master’s degree students of the Department of Process and Environmental Engineering
Prerequisites and co-requisites:
The courses 477011P and 488011P 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 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:
University lecturer Mika Huuhtanen.
Working life cooperation:
No
Other information:
-

477106S: Recycling of Bioproducts, 3 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Process and Environmental Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Ari Ämmälä

Opintokohteen kielet: Finnish

Leikkaavuudet:

477128S	Circular Bioeconomy	5.0 op
477125S	Recycling of bioproducts	5.0 op
470311S	Recycled Fiber Processes	2.5 op

ECTS Credits:
3 cr
Language of instruction:
Finnish
Timing:
Implementation in period 2 every other year.
Learning outcomes:
Upon completion of the course, a student is able to assess biomaterial and biocomposite recyclability and the importance of related unit processes. A student should be able to identify the unit operations of recycled fibre processing and explain their key operational principles. Regarding paper and board reuse a student understands the most important chemicals and their functions in recycling process. 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:
Bioproduct and biocomposite reuse and recycling as a part of product life-cycle in biomaterial and bioenergy value chain, including the most essential unit processes; biomaterial refining and classification, separation processes and recycle material analysis. Role of internal bioproduct recycling in biorefineries. Raw materials in paper and board product recycling and their unit operations.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures
Target group:
Students interested in bioeconomy
Prerequisites and co-requisites:
477103A Bioproduct technology is recommended
Recommended optional programme components:
-
Recommended or required reading:
Book series: Fapet Oy. Papermaking Science and Technology, book 7. Recycled Fiber and Deinking, 649 s.; Smook, G. A.: Handbook for Pulp and Paper Technologists. Vancouver 1992, 419 s. Lecture materials and other materials that will be announced at the lectures.
Assessment methods and criteria:
Exam. Literature exam possible for foreign students.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
0-5
Person responsible:
Education coordinator
Working life cooperation:
No
Other information:
Literature exam possible for foreign students.

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

Opintokohteen kielet: English

Leikkaavuudet:

477312S Science and Professional Ethics 5.0 op

ECTS Credits:
3 cr
Language of instruction:
English
Timing:
Implementation in spring semester during 4 th period.
Learning outcomes:
After the course the student is capable of explaining the meaning of research ethics 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 duties of a researcher and their 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 good research, Scientific community and ethical problems in research work. Professional ethics of a researcher and an engineer. 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 ethics in Finland and globally, Instructions for preventing, handling and examining misconduct and fraud in good scientific practices and 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.
Learning activities and teaching methods:
Lectures 25 h, practical work 15 h.
Target group:
Master's degree students of the Department of Process and Environmental Engineering.
Prerequisites and co-requisites:
-
Recommended optional programme components:
-
Recommended or required reading:
Clarkeburn, H. & Mustajoki, A. Tutkijan arkipäivän etiikkaa. Tampere 2007, Vastapaino.319 p., Good scientific practice and procedures for handling misconduct and fraud in science. Helsinki 2002, TENK, National Advisory Board on Research Ethics.,Guidelines for the Prevention, Handling and Investigation of Misconduct and Fraud in Scientific Research.Helsinki 1998, TENK, National Advisory Board on Research Ethics., Martin, M.W. &Schinzinger, R. Ethics in Engineering, 4th Edition. New York, 2005, McGraw Hill Co. 339 p.
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 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 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 cr
Language of instruction:
Finnish, can be completed in English as a book examination.
Timing:
Implementation in autumn semester during 2 nd and 3 rd periods.
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.
Mode of delivery:
Lectures including exercises.
Learning activities and teaching methods:
Lectures 40 h, exercises 20 h and homework 16 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 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:
King, C.J.: Separation Processes, McGraw-Hill, 1980, 850 p.; Noble, R.D. & Terry, P.A.: Principles of Chemical Separations with Environmental Applications. Cambridge 2004, Cambridge University Press, 321 p.
Additional literature: Henley, E.S. &Seader, J.D.: Equilibrium Stage Separation Operations in Chemical Engineering, John Wiley & Sons, 1981, 742 p.; McCabe, W.L. et al.: Unit Operations of Chemical Engineering, 5th ed., McGraw-Hill, 1993, 1130 p.; Rousseau, R.W.: Handbook of Separation Process Technology, John Wiley & Sons, 1987, 1010 p.
Assessment methods and criteria:
Homework assignments affect the course grade. Examination.
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 Riitta Keiski
Working life cooperation:
No
Other information:
-

477503S: Simulation, 3 op

Voimassaolo: 01.08.2005 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Process and Environmental Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Esko Juuso

Opintokohteen kielet: English

Leikkaavuudet:

477523S	Simulation	5.0 op
470448A	Simulation	3.0 op

ECTS Credits:
3 cr
Language of instruction:
Finnish and English
Timing:
Implementation in 3 rd period. Recommended for fourth year students (M.Sc.).
Learning outcomes:
After the course the student is capable of explaining the concepts and operation principles of process simulators. 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 event based, 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 26 hrs, including lectures, demonstrations, exercises and seminars. Totally 54 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 prerequisites.
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 the exercises, case study, seminar and the final report. Final exam is an alternative for the final report.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
The course unit uses a numerical grading scale 1-5. In the numerical scale zero stands for a fail.
Person responsible:
University teacher Esko Juuso
Working life cooperation:
No
Other information:
-

488122S: Statistical Methods in Hydrology, 5 op

Voimassaolo: 01.08.2011 - 31.07.2017

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Process and Environmental Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Björn Klöve, Pertti Ala-Aho

Opintokohteen kielet: English

ECTS Credits:
5 cr
Language of instruction:
English
Timing:
The course unit is held in the autumn semester, during periods 2-3
Learning outcomes:
By completing the course, students will be able to explain and apply the general statistical methods used in hydrology. Students can understand for describing a relationship between two hydrologic variables what type of statistical analyses are mostly used. In addition, students can show their findings from the statistical methods analysing in different plot types which are conventional in hydrology and water resources management. Considering some scientific guidelines for writing the reports of assignments, students can be familiar with scientific writing much more than the past.
Contents:
Statistical analyses of a hydrologic variable: 1) Summary statistics like mean, maximum, minimum, median, standard deviation and etc. 2) Probability distributions such as histograms, box, quantile and plots of normal, gamma, log-normal and generalized extreme value distributions. 3) Analyzing and plotting of significant correlations between a hydrologic variable and a meteorological variable. 4) Using regression line model with 95% confidence and prediction intervals, and also check residuals of the model. 5) Trend and time series analysis, and plotting time versus data in anomaly and scatter plots.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
In total, 135 hours of learning activities consisting of lectures (9 h), instructed computer sessions (18 h), and return assignments (108 h)
Target group:
Master students in the water engineering orientation 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, and 477033A Programming in Matlab or corresponding Matlab skills
Recommended optional programme components:
-
Recommended or required reading:
Helsel, D.R., & Hirsch, R.M., 2002. Statistical Methods in Water Resources (available online). Loucks, D.P., van Beek, E., Stedinger, J.R., Dijkman J.P.M., Villars, M.T., 2005. Water Resources Systems Planning and Management (available online).
Assessment methods and criteria:
Variable assessment methods where each submission is graded an weighted separately: A) report of group work on assignments (3 return assignments in total 75%), and B) final exam (25%)
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Final grade of the course is average of assignments and final exam. In the numerical scale zero stands for a fail.
Person responsible:
Professor Björn Klöve
Working life cooperation:
No
Other information:
The course is arranged in alternate years (odd autumn semesters).

488105A: Water Supply Networks, 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: Pekka Rossi

Opintokohteen kielet: Finnish

Leikkaavuudet:

480120A Water Distribution and Sewerage Networks 3.5 op

ECTS Credits:
5 cr
Language of instruction:
Finnish
Timing:
The course unit is held in the spring semester, in period 5
Learning outcomes:
Student knows and understands those systems what are needed for water distribution and waste water and storm water collection. Student is able to do basic dimensioning for water distribution network and sewer system of population centre.
Contents:
Water and drainage pipe design and dimensioning. Pumping and storage tanks needed in distribution of water and collection of sewage water. Control and automation of pumping stations. Observations in pipelines to prevent corrosion, effects of cold climate and harmful hydraulic impacts.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures and a design exercise.
Target group:
Students in master program of environmental engineering
Prerequisites and co-requisites:
No
Recommended optional programme components:
The recommended prerequisite is the completion of the following course prior to enrolling for the course unit: 488102A Hydrological Processes, 477303A Mass Transfer, 488011P Introduction to Environmental Engineering or at least equivalent information about water management.
Recommended or required reading:
Lecture handout and other materials delivered in lectures. To the appropriate extent: RIL 124-1.2003: Vesihuolto I (ISBN 951-758-503-3), RIL 124-2.2004: Vesihuolto II (ISBN951-758-438-5), Water distribution systems handbook. 2000 (ISBN 0-07-134213-3). Vesihuoltoverkkojen suunnittelu - perusteet ja toiminnallisuus (ISBN 978-951-758-526-2). RIL 237-2-2010, Vesihuoltoverkkojen suunnittelu - mitoitus ja suunnittelu (ISBN 978-951-758-521-7).
Assessment methods and criteria:
Examination and a design exercise.
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:
Pekka Rossi
Working life cooperation:
No
Other information:
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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 cr
Language of instruction:
English
Timing:
The course unit is held in the autumn semester, during periods 1-2
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 (50 h), exercises (40 h), self-study (45 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: 488011P Introduction to Environmental Engineering
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:
Course can be completed A) by book examination (Kemira), the lecture examination and to do 2 exercises OR B) by the final examination and to do 2 exercises.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.
Person responsible:
Laboratory Engineer Jarmo Sallanko
Working life cooperation:
No
Other information:
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