CHEM-C2160 - Yksikköoperaatiot

The English language study plan

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Chemical engineering

**General**

In the course, we first familiarize ourselves with the key phase equilibria in separation operations with the help of graphs and models. Then some of the most typical unit operations in chemical engineering are introduced, such as distillation, extraction, absorption, evaporation, dissolution and washing, adsorption, ion exchange, chromatography, crystallization, wet gas treatment, drying, membranes and filtration. Among these, some of the most important unit operations are discussed in a little more detail so that the student learns the most important aspects related to the dimensioning of equipment and the principles and benefits of different operating methods (e.g. countercurrent). Other unit operations are introduced at the level of operating principle.

The course also includes introduction to the mass transfer between phases and its importance in chemical engineering processes, mechanistic (physical-chemical) modeling of processes and the selection of a suitable separation method. The course introduces process simulation with the help of a typical process simulator commonly used in industry (Aspen Plus). The simulator also deepens the knowledge of phase-equilibria and some unit operations. The course provides the skills to understand the operation of industrial unit operations and a good foundation for master's studies in process technology.

**Learning outcomes**

After the course, the student:

* Knows the most common separation operations and knows how to choose a separation method based on the need.
* Can interpret phase equilibrium diagrams and choose phase balance models and solve them with appropriate software.
* Knows the operating principle of process simulators and is able to solve material and energy balances of simple processes, is able to set specifications and optimize processes.
* Is able to find in the open literature and to apply empirical correlations to estimate model parameters for physical properties and processes.
* Understands the principles of mechanistic modeling of industrial processes and can create simple process models and solve them in a process industry context.
* Knows the basic dimensioning of some separation operations.

**Contents**

* Separation operations
* Mechanistic modeling of chemical processes
* Use of process simulators
* Introduction to process and equipment design in the chemical industry
* Industrial examples

**The estimate of the workload (%)**

* Theory 24 h, independent study (learning diary (5%)).
* Exercises 48 h, together with the Finnish students (English questions and answers) (active participation 15%).
* Home exercises 20 h (30%)
* Exam 43 h (50%)

**Grading**

* The theory, learning diary 5 %
* Exercises: Hand calculations and computer calculations 15%, activity points
* Home exercises 30%
* Exam 50 %

Completion of any part of the course is not mandatory, but at least 55% of the points must be obtained to pass. At least 85% of the points must be obtained for grade 5. If less than 5% of students are getting a grade of 5, this point limit can be lowered.

If all graded partial performances, except for the exam, have been done during the same year, they remain valid (you can take the exam). If you leave the course in such a way that you have some partial completions done, according to agreement, they can be accepted in later courses, but with reduced points.

**Lectures/Theory**

The English version of the course is a based on the student’s self-study guided by the instructions of the teachers. The lecture quizzes (5%) are replaced in the English version by a learning diary returned by the end of the periods. The guidelines to compile the learning diary is given by the teacher.

**Exercises**

The course has two types of exercises:

1. Hand (calculation with a calculator). During the manual exercise, work must be done, but the solutions do not have to be returned. Don't forget to ask for help during the exercises! An activity point is granted when attending the exercise.
2. Exercises done on the computer. There are two groups of exercises, in which the same calculations are reviewed but in a different order. An activity point is granted when attending the exercise (only once).

The solutions to the exercises come to the MC after the exercises.

**Home exercises**

The course has two homework assignments, the first one introduces Aspen's unit operation models and thermodynamics, and in the second one a flow chart of a simple process with recycling streams is solved.

Home calculations are basically done in groups of four. In exceptional cases, other group sizes are also allowed, but these must always be negotiated on a case-by-case basis before starting the work. The size of the group can affect the assessment.

The home exercise will not be returned for correction. If there are challenges in solving the exercises or in the group's dynamics, ask for advice immediately either in connection with the exercises or by e-mail from the person handling the exercise. The homework is not graded before they are returned. If the return of the exercise is delayed from the date of return, it will affect the grading of the exercise. If the exercise is significantly late, no points will be awarded for the exercise. The topics of the calculations are explained in the exercises. Start making the exercises early!

**Final exam and midterm exams**

* The final exam and midterm exams are based on the material distributed in the course (lectures, course handouts and solutions to the exercises). Other background material may also be uploaded to the MC, which is basically additional information for those interested. If the background material is part of the exam requirements, it will be announced separately.
* The exam and midterms have a theory and calculation part. In the theory part the students have only writing tools. The calculation part may include printed material. A calculator/computer may be included in the calculation part, but it may not be connected to anything (individual work!).

**Extra points**

If you find obvious mistakes (not just typos) in the course material, report it to the teacher in charge. If the mistake leads to a correction, you can get an extra point. If your proposal was not a mistake, it will not be punished, i.e. no minus points will be awarded.

You can also suggest exam questions. A great suggested question might end up in the exam you're taking, and they might also be awarded extra points. You can also get an extra point if you give course feedback that leads to improvements in the course either on the exam or midterm exam paper or by email to the teacher in charge.