

CHEM-A1120, Virtaustekniikka ja lämmönsiirto, 5 op

The version for English speaking students

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Chemical engineering

### **General**

The course is an introduction to two key areas of chemical engineering, fluid flow and heat transfer. Fluid flow deals with how fluids (liquids and gases) move, and how to move them sensibly in industrial processes. As the name suggests, heat transfer considers the heat transfer with different mechanisms, and how the temperatures of different streams are managed in industrial processes. Thus, the course has two themes, both of which are discussed from the perspective of both science and technology. The themes are closely related to energy, and the tools are mechanical and thermal energy balances. Based on these, models are built based on scientific know-how. These models are used to design industrial, large-scale processes, when the models are combined with practical know-how.

### **Learning outcomes**

After the course, the student:

- Knows the basic concepts of fluid flow, such as laminar and turbulent flow, pressure drop and Newtonian and non-Newtonian fluids.
- Knows the mechanisms of heat transfer and their connection to heat transfer rates as part of the balances needed in the design of equipment.
- Knows the most typical pump types.
- Knows the basics of dimensionless numbers and knows how to use them.
- Can apply thermal and mechanical energy balances in technical applications, especially in the design of heat exchangers and pump and piping systems.

### **Contents**

- Mass and energy balances and their applications
- Heat transfer and heat exchangers
- Pumps, piping, compressors, and mixing

### **Amount of work (% of grade)**

- Theory (English speaking students replaces the lectures by independent study compiling a learning diary) 24 h
- Exercises 48 h in classroom (English speaking students replaces quizzes related to theory studies and exercises by compiling a learning diary) (20%)
- Home exercises 2 pcs, total 20 hours (30%)
- Independent study and exam or midterms 43 h (50%)

We have tried to implement the scoring in such a way that it corresponds to the workload as well as possible. The workload related to the lectures/theory and a large part of the workload of the exercises are included in the evaluation of the final exam. The exercises also support home calculations.

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.

## **Theory**

The theory is studied as independent study by compiling a learning diary in the English version of the course. The teachers will give a list of suitable course books and other directions how to include and compile a learning diary of the course.

## **Exercises & learning diary**

### Calculation exercises

Exercises with calculations to be done by hand (pen, paper and a suitable calculator/computer). There are two training sessions of similar content per week, which are carried out in an "exercise clinique" -style. Students solve tasks (alone or in groups) and teachers help. There are videos to support calculating the exercises. Bring your PC, phone and headphones. Remember to actively ask for help with making the exercises! You can participate in both practice sessions. The activity in participating the exercises (10%) is controlled in the learning diary which is graded by the teacher.

(The groups are divided naturally according to the teachers' experience, but if you have no other reason for choosing a group, primarily choose the first group Thursday, if your last name is A-L, the second group Tuesday M-Ö.)

### Learning diary

The English-speaking students prepare a learning diary which is replacing the quiz-based exercise on the lectures and Finnish language handouts (Theory) and the activity quiz for exercises. The teacher will give instructions to compile the learning diary.

There are no substitute tasks for training participation.

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

## **Homework assignments**

The course has two homework assignments, one of which is related to fluid flow and the other to heat transfer.

Home assignments are basically done in groups of four. In some 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 assignments will not be returned for correction. If there are challenges in solving the homework or in the group's activities, ask for advice immediately either in connection with the exercises or by e-mail from the person handling the assignment. Assignments are not graded before they are returned. If the return of the exercise is delayed from the last return date, it will affect the evaluation of the exercise. If the lateness is significant, no points will be awarded for the bill. The topics of the calculations are explained in the exercises. Start making the assignments 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.

## **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. You can also suggest exam questions. A great suggested question might end up in the exam you are 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.