Simulation and design tools

Lecturers
Frédéric DEBASTE (Coordinator) and Tom VAN ASSCHE

Course mnemonic
CHIM-H514

ECTS credits
4 credits

Language(s) of instruction
English

Course period
First term

Course content

This course is divided in two parts :

The first part deals with :

- Basic of process simulation
- Practical simulation of an existing complex chemical process.
- Practical simulation of the flow in different processes.

The second part of the course is devoted to the use of Computational Fluid Dynamics (CFD) for the analysis and the design of unit operations used in environmental processes. After a brief introduction to CFD, concrete problems are considered. In most cases, the problems tackled in this course are issued from collaborations between ULB and the industrial world and illustrate various aspect of chemical engineering

Objectives (and/or specific learning outcomes)

- The objective of this course is to give a brief overview of Computation Fluid Dynamics and its potential for the analysis and the design of industrial processes.

For the second part, at the end of the course, the student should be able to :

- Understand the principles, strenghts and weaknesses of CFD
- Evaluate the interest of using CFD for a given problem
- Identify what information they would like to obtain from CFD
- Design a simulation that offers an efficient solution
- Implement that solution
- Critically discuss the obtained solution

Teaching method and learning activities

talk (few); exercices

Part II is divided in 6 sessions of 4h.

The first session, is the only including a ex caethedra presentation (~1h30) which is devoted to an introduction to CFD, a presentation of the aims and methodology of the 6 sessions and a presention of the CFD tools that is used. The rest of the session (~2h30) is devoted to guided tutorial on computer that the student realize to have a first grasp on the software.

Sessions from the 2 to the 5 follow a common general approach. Each session has to be prepared by the student threw a 4-5 page reading of basic concepts. Each session begins with a time for Q&A about the reading (15 minutes) and a short oral evaluation of the student (15 minutes). Then a set of practical case of growing complexity are given to the students to be solved on the computer. Solutions and analysis of these solutions are discussed during the session except for the last exercice of each session. For this last exercice, each student must submit a 1 page report for the next week.

Each of these session will have a dedicated theme :

Session 2 : meshing accuracy and model validation

Session 3 : Turbulent flow modelling and boundary layers

Session 4 : Multiphysics modelling

Session 5 : Problem optimization

The last session will be dedicated to an open problem based on a litterature case to be solved and presented at the oral examination.

Contribution to the teaching profile

This teaching unit contributes to the following competences:

- In-depth knowledge and understanding of integrated structural design methods in the framework of a global design strategy
- In-depth knowledge and understanding of the advanced methods and theories to schematize and model complex problems or processes
- Reformulate complex engineering problems in order to solve them (simplifying assumptions, reducing complexity)
- Collaborate in a (multidisciplinary) team
- Work in an industrial environment with attention to safety, quality assurance, communication and reporting
- A creative, problem-solving, result-driven and evidence-based attitude, aiming at innovation and applicability in industry and society
- Consciousness of the ethical, social, environmental and economic context of his/her work and strives for sustainable solutions to engineering problems including safety and quality assurance aspects
- The flexibility and adaptability to work in an international and/or intercultural context
- An integrated insight in chemical process and materials' technology

References, bibliography and recommended reading

Part II: An introduction to Computational Fluid Dynamics, H.K. Versteeg and W. Malalasekera, Prentice Hall

Other information

Contact(s)

Part I: Harry Verelst (hverelst@vub.ac.be)

Part II: Frédéric Debaste (fdebaste@ulb.ac.be)

Evaluation method(s)

Other

Evaluation method(s) (additional information)

For part II : The assessment is mainly targetting practical skills of the student and their ability to be reflexive on their modeling choices.

The assesment is realized through oral examination.

Determination of the mark (including the weighting of partial marks)

Part I and II each count for 50% of the final note.

For part II, of a total of 100%, the wheighing is :

20% for the technical reports

20% for the oral questions during the session

60% for the final oral examination

Main language(s) of evaluation

English

Programmes

Programmes proposing this course at the Brussels School of Engineering

MA-IRMA | Master of Science in Chemical and Materials Engineering | finalité Professional/unit 2