Fall 2025

ChE-413: Chemical Engineering Product Design

Instructor
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Teaching Assistants
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Classroom
MA A1 12

Meeting time
Tuesday, 15:15 – 18:00
Lectures will be done in the first two sessions (15h15 to 16h00, 16h15 to 1700), and exercises in the last session (17h15 to 18h00). The teaching assistant will conduct the exercise session, focusing on the course concepts taught in the first two sessions.

Moodle Site
Course information, including the syllabus, lecture notes, and announcements, can be found at the Moodle site.
https://moodle.epfl.ch/course/view.php?id=15270

Course Summary
This course presents the basic method for chemical product design and gives direct practice to this procedure via a design project. This prepares students for the Chemical Engineering industry, where chemical product design has become an integral part.

Intended Learning Outcome
By the end of the course, students should be able to

Identify and translate customer needs
1. Distinguish between *essential, desirable, and useful* product requirements.
2. Synthesize multiple ideas to meet product specifications, disregarding preconceptions.

Formulate product specifications
1. Convert vague needs into measurable engineering specifications.
2. Develop quantitative specifications using chemical reactions, mass and energy balances, and rate processes.

Generate and evaluate product ideas
1. Apply structured brainstorming methods to create multiple design concepts.
2. Use selection criteria to evaluate, compare, and prioritize product concepts.
3. Identify and evaluate risks of a product.

Integrate chemical engineering principles into design
1. Consider manufacturing processes and economic aspects in final product design.
2. Evaluate environmental, regulatory, and ethical constraints in product design.

Collaborate and communicate effectively
1. Manage long-term projects and work in a team.
2. Present product design solutions to the project coach in clear written and oral formats.
3. Work in a team to integrate technical, business, and customer perspectives.

Course Content
Exploration of a simplified 4-step process for chemical product design.

List the Needs of the product
1. Categorize the needs as Essential, Desirable, or Useful.
2. Convert vague or qualitative needs into quantitative specifications.

Develop a list of 20-200 Ideas that could satisfy the needs of the project.
1. Sort these ideas into 4 or 5 broad approaches.
2. Screen the ideas to identify the top ideas in each approach using quick calculations.

Select the best ideas for further development
1. Using kinetic or thermodynamic analysis together with a selection matrix technique.
2. Assess the risk with each of the top ideas.

Preparation for manufacture
1. Evaluate the economic potential of the product.
2. Write an executive summary of a business plan.

Textbooks
Cussler, E. L.; G. D. Moggridge. *Chemical Product Design* (Cambridge Series in Chemical Engineering) Second Edition. (Available at EPFL library, click here to get to the library page)

Teaching Method
1. Projector slides would be used to deliver the course content to the students in class.
2. Some exercise problems will be conducted during the lecture. The rest of the exercise problems will be conducted during the last hour of the class (exercise session).
3. Lecture notes of a specific class will be available on the Moodle page (https://moodle.epfl.ch/course/view.php?id=15270) before the class.

Grades
1. Homework (3 in total, each 10% of the total grade, overall, **30%** of the total grade).
2. Meeting and presentation with project coach (in a team of 3-4, 3 meetings, each 10% of the total grade, overall, **30%** of the total grade).
3. Final project report (in a team of 3-4, **25%** of the total grade)
4. Final Oral Presentation exam (in a team of 3-4, **15%** of the total grade)

About the Homework
There will be three homework sets in total; each associated with a lecture topic from the first part of the course. Homework is to be performed individually and uploaded one week after the corresponding lecture (by 15h00).

About the Group Project
The second part of the course is a project that will be performed in small groups (3-4 students), where each group will be assigned a design project and will follow the simplified design process developed in the lecture part of the course. Full details will be given on **October 7** in the lecture room MA A1 12 at 15h15.

Schedule for Homework/Assignments:

Task/Assignment	**Percent of final mark**
Homework 1 (Due on Moodle September 16)	10% (individual)
Homework 2 (Due on Moodle September 23)	10% (individual)
Homework 3 (Due on Moodle October 7)	10% (individual)
Meeting 1 (Oral presentation by core team and discussion with the project coach)	10% (Group)
Meeting 2 (Oral presentation by core team and discussion with the project coach)	10% (Group)
Meeting 3 (Oral presentation by core team and discussion with the project coach)	10% (Group)
Final report (Due on Moodle December 9)	25% (Group)
Final oral presentation (December 16, MA A1 12)	15% (Group)