COURSE DESCRIPTION CARD - SYLLABUS

Course name
Industrial process design [S2TCh2-PTiB>PPP1]

Course

Field of study
Chemical Technology

Year/Semester
1/1

Area of study (specialization)
Technological Processes and Bioprocesses

Profile of study
general academic

Level of study
second-cycle

Course offered in
polish

Form of study
full-time

Requirements
compulsory

Number of hours

Lecture
0

Laboratory classes
0

Other (e.g. online)
0

Tutorials
0

Projects/seminars
60

Number of credit points

4,00

Coordinators

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Lecturers

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Prerequisites

Student has knowledge of mathematics to the extent that allows him to use mathematical methods to describe chemical processes and make calculations needed in engineering practice. Student has knowledge in the basic field related to the selection of materials used in the construction of chemical equipment and installations. Student knows the basics of kinetics, thermodynamics and catalysis of chemical processes.

Course objective

The aim of the course is to learn how to design unit operations and equipment of the chemical industry on the basis of the design of the entire chemical plant. The design of the whole chemical installation gives an opportunity to learn about many types of unit operations cooperating together in one installation. An important aspect of the subject is the use of a design support tool CAD - Chemcad.

Course-related learning outcomes

Knowledge:
The student acquires knowledge in the area of chemical equipment design, application of thermodynamic models and taking into account different levels of complexity in the project. The student understands the necessity of using numerical procedures by the software and their significant influence on the way of conducting calculations. (K_W01, K_W03, K_W06, K_W07)

Skills:
Students will have skills to create a project on three levels of complexity: basic balance based on defined design requirements and declared flows, rating the dimensioning of equipment and hydraulics based on defined pressures. The student is able to identify key problems related to system non-ideality, eliminate incorrect and illogical installation settings and conduct analysis based on the use of parametric sensitivity technique. (K_U01, K_U06, K_U07, K_U14)

Social competences:
The student is aware of the impact of applied solutions in the project on the environment. Particular emphasis is placed on the impact of the installation on the environment through the identification of environmental hazards using the WAR procedure. (K_K02)

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Semester evaluation of the completed project, consisting of a preliminary pre-project analysis, the quality of the completed project and the preparation of the final report.
In the case of the classroom version of the course, assessment takes place in the computer lab, while in the case of online classes, assessment takes place using the university's network-computer infrastructure (VPN) via the Remote Desktop Protocol (RDP) using the remote desktop connection tool.

Programme content

Unit operations and mass balance, ion balance, and heat balance. Application of CAD engineering aid tools to determine technical specifications of apparatus, including: vessel and tubular chemical reactors, distillation columns (tray and packed), heat exchangers, separation vessels, pipelines, control valves, hydraulic equipment. Validation analysis for sized equipment. Hydraulic analysis using calculations based on pressure and flow balancing of pipelines, control valves, pumps and compressors. The design is based on the steady-state description of the processes and ultimately leads to the most optimal solution from the point of view of the product to be obtained. The project should achieve the so-called TRL (technology readiness level) of 5.
An additional element is to perform an environmental analysis, i.e. the impact of the designed installation and the substances used on the environment.

Teaching methods

Extensive presentation of the using and operation of the design support tool - Chemcad. Detailed overview of individual unit operations available in Chemcad. Detailed analysis and explanation of the ways of declaring the kinetics of chemical reactions with formulations significantly deviating from the classical arrhenius forms. Presentation of methods of taking into account chemical catalysts. Demonstration of methods of automatic and semi-automatic equipment sizing for a specific processes. Based on the presented examples, the students perform preliminary, test projects of single unit operations during the classes. At this stage, the teacher assists students in the use of the CAD tool, without solving any design problems.
During the final semester project, students are assisted in the area of functioning of the Chemcad program, but they make design decisions for which they are responsible. All solutions for schematic flow routing, media application, equipment selection, process settings, design requirements, structural sizes are within the students' area of initiative and responsibility.

Bibliography

Basic:
Ruch ciepła i wymienniki / Tadeusz Hobler. Autor: Hobler, Tadeusz. Wydawnictwa Naukowo-Techniczne, 1986.
Dyfuzyjny ruch masy i absorbery / Tadeusz Hobler. Autor: Hobler, Tadeusz. Autor, Wydawnictwa

Naukowo-Techniczne. Wydawnictwa Naukowo-Techniczne, 1976.

Additional:
Projektowanie systemów procesowych, Krzysztof Alejski, Maciej Staszak, Piotr Wesołowski. Politechnika Poznańska. Wydawnictwo Politechniki Poznańskiej, 2013.

Breakdown of average student's workload

	Hours	ECTS
Total workload	100	4,00
Classes requiring direct contact with the teacher	60	2,50
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	40	1,50