COURSE DESCRIPTION CARD - SYLLABUS

Course name
Design of low emission industrial processes [S2TOZ1-TSO>PNPP]

Course

Field of study
Circular System Technologies

Year/Semester
2/3

Area of study (specialization)
Renewable raw material technologies

Profile of study
general academic

Level of study
second-cycle

Course offered in
Polish

Form of study
full-time

Requirements
elective

Number of hours

Lecture
0

Laboratory classes
0

Other
0

Tutorials
0

Projects/seminars
30

Number of credit points

2,00

Coordinators

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Lecturers

Prerequisites

Student knows basic chemical processes in industrial scale and principles of chemical production. Students will be able to obtain information from literature, databases and other sources in the field of chemical and environmental sciences, they will be able to interpret it, draw conclusions and formulate opinions. The student understands the need for further education and improvement of his professional and personal competences.

Course objective

Design the installation of a selected industrial process based on renewable raw materials, taking into account the principles of the circular economy (CE) and best available technologies (BAT).

Course-related learning outcomes

Knowledge:
Student has advanced, detailed knowledge covering issues in the field of sustainable production, principles of conduct and development trends in a circular economy. K_W03
Student has in-depth and theoretically underpinned knowledge of modern environmentally friendly technologies. K_W05

Student has in-depth knowledge allowing to design technological processes based on the principles of circular economy. K_W07

Skills:
Student has the ability to communicate verbally with specialists in the area of circular economy and related fields. K_U01
Student has the ability to use the knowledge he/she possesses to identify and select methods of disposal/management of various industrial wastes taking into account the principles of the circular economy and to propose improvements to existing technological solutions taking into account the applicable legislation. K_U03
Student is able to interact with others and take a leading role in a team in order to solve engineering problems concerning methods and equipment used in technologies, including those related to the circular economy. K_U09
Student is able to use the knowledge he/she possesses to design, document and evaluate a process flow in the field of circular technologies, analyse the possibility of integrating unit processes due to raw material, by-product and final product, according to the principles of material and energy saving, taking into account the principle of risk assessment. K_U14
Student is able to analyse and critically evaluate new areas in technologies applied in the ccircular economy and related fields, assess their innovativeness and technical feasibility. K_U16

Social competences:
Student is aware of personal responsibility resulting from his/her professional role and of the emergence of moral and ethical issues in the context of professional activities. K_K01
Student understands the need to popularise knowledge on sustainable production and technological solutions in a circular economy. K_K02
Student critically assesses knowledge, understands the need for further education and improvement of his/her professional, personal and social competences. K_K03

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Semester evaluation of completed projects, consisting of a preliminary pre-project analysis, the quality of the completed project and the production of a final report.

Programme content

The course programme focuses on the design of innovative industrial installations that use renewable raw materials and operate according to the principles of the circular economy (CE) and best available technology (BAT). The course aims to develop practical skills in designing efficient, sustainable and low-carbon industrial processes

Course topics

The course covers advanced mass and thermal balancing methods, key to designing efficient industrial processes, with an emphasis on minimising waste and maximising the use of raw materials. Strategies for the design of plants using renewable raw materials are discussed in detail, including an analysis of how these raw materials can be integrated into existing processes and the creation of new, innovative processes. The programme looks in detail at how CE principles can be implemented in industrial projects, including strategies for waste reduction, recycling and reuse of materials.
The course includes a discussion of Best Available Technologies (BAT) and their application in reducing emissions and increasing energy efficiency. Training in the use of Chemcad software in the design, simulation and optimisation of industrial processes is an important part of the programme, with a particular focus on low-carbon processes. The programme also includes validation analysis for designed equipment and systems, including hydraulic analysis based on balancing pressures and flows in pipelines, valves, pumps and compressors.
Detailed coverage of the design and optimisation of industrial apparatus, including reactors, distillation columns, heat exchangers, separation vessels and pipework, is an integral part of the course. The programme also includes detailed environmental studies of the designed installations, including the assessment of their overall environmental impact through the use of pollution reduction algorithms.

Teaching methods

Combining theoretical foundations with design exercises, this course prepares students to effectively design innovative, sustainable and low-carbon industrial processes that respond to today's environmental and technological challenges. This programme provides a comprehensive approach to modern industrial design, with an emphasis on the practical application of acquired knowledge in real-life design scenarios.

Bibliography

Basic:
1. K. Schmidt, J. Sentek, J. Raabe, E. Bobryk, Podstawy technologii chemicznej. Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2004.
2. T. Grzywa, J. Molenda, Technologia podstawowych syntez chemicznych, tom 1 i tom 2, WNT, Warszawa 2008.
3. K. Staszak, K. Wieszczycka, B. Tylkowski, Chemical Technologies and Processes , de Gruyter, 2020.
4. I. Bąk, K. Cheba, Zielona gospodarka jako narzędzie zrównoważonego rozwoju, CeDeWu, Warszawa 2020.
5. Best avaliable techniques (BAT).

Additional:
1. Current articles
2. Relevant Decrees of the Minister of the Environment and EU Directives

Breakdown of average student's workload

	Hours	ECTS
Total workload	50	2,00
Classes requiring direct contact with the teacher	30	1,00
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	20	1,00