STUDY MODULE DESCRIPTION FORM

Name of the module/subject **Environmental protection in chemical technology and green**		Code **1010705231010722069**
Field of study **Chemical Technology**	Profile of study (general academic, practical) **(brak)**	Year /Semester **2 / 3**
Elective path/specialty **General Chemical Technology**	Subject offered in: **Polish**	Course (compulsory, elective) **obligatory**
Cycle of study: **Second-cycle studies**	Form of study (full-time,part-time) **part-time**	
No. of hours Lecture: **40** Classes: **-** Laboratory: **-** Project/seminars: **-**		No. of credits **4**
Status of the course in the study program (Basic, major, other) **(brak)**	(university-wide, from another field) **(brak)**	
Education areas and fields of science and art **technical sciences** **Technical sciences**		ECTS distribution (number and %) **4 100%** **4 100%**

Responsible for subject / lecturer:

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Responsible for subject / lecturer:

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Prerequisites in terms of knowledge, skills and social competencies:

1	**Knowledge**	Student has the necessary knowledge in the field of chemistry for the understanding of phenomena and chemical processes. Student has the necessary knowledge of raw materials, products and processes used in chemical technology.
2	**Skills**	Student can obtain the necessary information from literature, databases and other sources, properly interpret them, draw conclusions, formulate and justify opinions.
3	**Social competencies**	Student understands the need for further education and improve his professional skills, personal and social, can think and act in an entrepreneurial manner.

Assumptions and objectives of the course:

Obtaining knowledge of the principles and objectives of green chemistry focused on sustainable development, the production of modern chemical product safety, economic means, while protecting the environment.

Study outcomes and reference to the educational results for a field of study

Knowledge:

1. Student has a broader and deeper knowledge of green chemistry, allowing for formulating and solving complex tasks associated with chemical technology. - [K_W02]
2. Student has expanded knowledge of environmental problems associated with chemical processes. - [K_W08]

Skills:

1. Student is able to independently determine the direction of further education and pursue self-directed learning. - [K_U05]
2. Student has the ability to adapt the knowledge of green chemistry to solve problems in the field of chemical technology and planning of new industrial processes. - [K_U11]
3. Student can rationally plan the use of raw materials in the chemical industry, guided by the principles of environmental protection and sustainable development. - [K_U12]

Social competencies:

1. Student has formed awareness of the limitations of science and technology related to chemical technology, including environmental. - [K_K02]
2. Student understands the need to provide public information about the current status and directions of development of chemical technology, on the basis of use and handling of chemical products, the risks associated with the acquisition of raw materials, chemical production and distribution. - [K_K07]

Assessment methods of study outcomes

Written test.

Course description

The objectives and principles of green chemistry. Unconventional ways of conducting a chemical reaction (electrochemical synthesis, photochemical, sonochemical, using microwave radiation, no solvents). Alternative reaction media (water, supercritical fluids, water and carbon dioxide, ionic liquids, liquid fluorine). Patents in green chemistry. Examples of application of green chemistry principles in the industry - the President of the United States Award (Presidental Green Chemistry Challenge Awards). Green Engineering (definition, principles of Anastas and Zimmerman, Sandestin rules). Quantitative measures of sustainable chemistry. Prospects for the development of green chemistry and its future tasks.

Basic bibliography:

1. Burczyk B.: Zielona chemia. Zarys, Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2006.
2. Paryjczak T., Lewicki A., Zaborski M.: Zielona chemia, Wydawnictwo PAN, Łódź 2005.
3. Burczyk B.: Biomasa. Surowiec do syntez chemicznych i produkcji paliw, Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2011.
4. Burczyk B., Woda: użyteczne i nieszkodliwe dla środowiska naturalnego medium reakcyjne, Przem. Chem. 86/3 (2007) 184-194.
5. Nazimek D., Kataliza i katalizatory w ochronie środowiska, Przem. Chem. 84/2 (2005) 162-166.
6. Paryjczak T., Lewicki A., Kataliza w zielonej chemii, Przem. Chem. 85/2 (2006) 85-95.

Additional bibliography:

1. Matlack A.S., Introduction to green chemistry, New York; Basel; Marcel Dekker, 2001.
2. Nelson W.M., Green solvents for chemistry: perspectives and practice, Oxford: Oxford University Press, 2003.
3. Clark J. H., Green chemistry: today (and tomorrow), Green Chem., 2006, 8, 17-21.
4. Höfer R., Bigorra J., Green Chemistry - a Sustainable Solution for Industrial Specialties Applications, Green Chem., 2007, 9, 203-212.

Result of average student's workload

Activity	Time (working hours)
1. Lectures	40
2. Participation in the consultations	30
3. Preparation for written test	30

Student's workload

Source of workload	hours	ECTS
Total workload	100	4
Contact hours	70	3
Practical activities	30	1