STUDY MODULE DESCRIPTION FORM

Name of the module/subject		Code
Green Chemistry		**1010702331010721729**

Field of study	Profile of study (general academic, practical)	Year /Semester
Environmental Protection Technologies	**(brak)**	**2 / 3**
Elective path/specialty	Subject offered in:	Course (compulsory, elective)
-	**Polish**	**obligatory**

Cycle of study:	Form of study (full-time,part-time)
Second-cycle studies	**full-time**

No. of hours				No. of credits
Lecture: **2**	Classes: **1**	Laboratory: **-**	Project/seminars: **-**	**5**

Status of the course in the study program (Basic, major, other)	(university-wide, from another field)
(brak)	**(brak)**

Education areas and fields of science and art	ECTS distribution (number and %)
technical sciences	**5 100%**
Technical sciences	**5 100%**

Responsible for subject / lecturer:

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Prerequisites in terms of knowledge, skills and social competencies:

1	**Knowledge**	Student has a structured, theoretically founded knowledge covering key issues in the field of environmental technologies.
2	**Skills**	Student can obtain information from literature, databases and other sources, also in English. Student can to interpret the information, draw conclusions and formulate and justify opinions.
3	**Social competencies**	Student can interact and work in a group. Student can prioritize appropriately used to perform a particular task.

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 detailed knowledge of green chemistry. - [K_W17]
2. Student has knowledge of the development trends and the most important new developments in the field of sustainable chemistry. - [K_W18]
3. Student has detailed knowledge of theoretical underpinnings associated with green chemistry in the field of environmental technology. - [-]

Skills:

1. Student can obtain information from literature, databases of green chemistry, can integrate the information, make their interpretation and critical evaluation, and to draw conclusions and formulate and fully justify opinions. - [K_U01]
2. Student can prepare and present an oral presentation on specific issues in the field of green chemistry - [K_U05]
3. Student can assess the suitability and ability to use new developments in green chemistry - [K_U12]

Social competencies:

1. Student is aware of the effects of engineering activities, including its impact on the environment and the associated responsibility for decisions. - [K_K03]

Assessment methods of study outcomes

Current control during exercise, written test.

Course description

The essence of green chemistry and sustainable development. 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). Renewable raw materials in organic synthesis (raw fats, carbohydrates, natural rubber). Issues of green chemistry in polymer materials. Green chemistry in agriculture (alternative pesticides and fertilizers). 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	30
2. Participation in exercises	15
3. Prepare for exercises	40
4. Participation in the consultation	25
5. Preparation for written test	15

Student's workload

Source of workload	hours	ECTS
Total workload	125	5
Contact hours	70	3
Practical activities	55	2