STUDY MODULE DESCRIPTION FORM

Name of the module/subject **Chemical Technology**		Code
Field of study **Environmental Protection Technologies**	Profile of study (general academic, practical) **general academic**	Year /Semester **3 / 5**
Elective path/specialty	Subject offered in: **Polish/English**	Course (compulsory, elective) **obligatory**
Cycle of study: **First-cycle studies**	Form of study (full-time, part-time) **full-time**	
No. of hours Lecture: **60** Classes: **-** Laboratory: **45** Project/seminars: **15**		No. of credits **7**
Status of the course in the study program (Basic, major, other) **basic**	(university-wide, from another field) **university-wide**	
Education areas and fields of science and art **technical sciences**		ECTS distribution (number and %) **7 100%**

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Prerequisites in terms of knowledge, skills and social competencies:

1	**Knowledge**	Student has knowledge of general, organic and inorganic chemistry, physical chemistry and apparatus of chemical industry, knows the basic methods, techniques and tools used in chemical analysis (core curriculum of I and II year of the studies)
2	**Skills**	Student can obtain information from literature, databases and other sources, can interpret the obtained information to draw conclusions and formulate opinions in the area of general and inorganic chemistry. Student is able to apply that knowledge in practice, both during the implementation work and the further education.
3	**Social competencies**	Student is able to interact and work in a group. Student is able to properly identify the priorities used to perform a specific task. Student understands the need for further education.

Assumptions and objectives of the course:

Acquiring basic knowledge in the field of organic and inorganic chemical technology. Understanding the basic industrial processes and operations related to organic and inorganic technology. Ability to select raw materials and chemical intermediates. Understanding the methods of obtaining organic and inorganic products and their identification. Indication of the possibility of using products manufactured in organic and inorganic technology processes. Proper waste handling. Proposal of using environmentally friendly technologies.

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

Knowledge:

1. The graduate has the necessary knowledge of chemistry to understand chemical phenomena and processes. - [**K_W03**]
2. The graduate has the necessary knowledge in the field of organic and inorganic chemical technology related to selection of materials used to set up equipment, apparatus and chemical installations and knows the principles of their functioning. - [**K_W05**]
3. The graduate knows the rules of environmental protection related to chemical technology and waste management. - [**K_W06**]
4. The graduate has a systematized, general theoretical knowledge of basic, organic and inorganic chemistry. - [**K_W07**]
5. The graduate has the necessary knowledge both of natural and synthetic raw materials, products and processes used in chemical technology, as well as directions of development of the chemical industry in Poland and around the world. - [**K_W08**]
6. The graduate knows the principles of construction, operation and selection of equipment, reactors and apparatus used in chemical technology. - [**K_W10**]
7. The graduate knows the basic methods, techniques, tools and materials used to solve simple tasks in technology and chemical engineering. - [**K_W11 and K_W12**]

Skills:

1. The graduate can obtain necessary information from literature, databases and other sources related to chemical technology, interpret them properly, draw conclusions, formulate and justify opinions. - [**K_U01**]
2. He is able to effectively solve elementary problems in the field of general, organic and inorganic chemistry and chemical technology based on literature and experimental data. - [**K_U13**]
3. He can effectively select raw materials and the method of obtaining a specific product in organic and inorganic chemical technology, taking into account economic and energy aspects. - [**K_U15**]
4. Can effectively distinguish types of chemical reactions and has the ability to select them in order to implement a specific chemical process. - [**K_U16 and K_U18**]

Social competencies:

1. The graduate understands the need to develop and improve their professional, personal and social competences. - [**K_K01**]
2. Student is aware of the effects of engineering activities and related responsibilities. - [**K_K02**]
3. Student has a sense of responsibility for collaborative tasks related to teamwork. - [**K_K03**]

Assessment methods of study outcomes

K_W03, K_W05, K_W06, K_W07, K_W08, K_W10, K_W11, K_W12 – exam

3	50.1%-70.0%
4	70.1%-90.0%
5	from 90.1%

K_U01, K_U13, K_U15, K_U16, K_U18 – reports from laboratory exercises, colloquium, oral/written answer, presentation of theoretical and experimental material, solving scientific problems

3	basic theoretical and practical knowledge, preparation skills concerning reports from laboratories and projects
4	practical preparation supported by theoretical knowledge, the ability to formulate the right conclusions from the data obtained during the laboratory and the projects
5	complete preparation for classes, the ability to draw conclusions at an advanced level, and also posed defense, preparation of project assumptions at a high substantive level and their presentation

K_K01, K_K02, K_K03 – assessment of student's activity in lectures, laboratory and project classes, evaluation of practical classes, evaluation of teamwork

3	basic participation in theoretical and practical classes without additional involvement
4	active participation in classes supported by the desire to acquire additional practical and theoretical knowledge
5	precise execution of entrusted tasks, independent search additional theoretical knowledge, coordination of work in a research team, an ambitious approach to the subject matter

Course description

Organic Technology:

1. Technological principles (principle of the best use of the potential difference, the principle of the best use of raw materials, energy, equipment, technological principle of moderation).
2. Sources of energy and raw materials.
3. Industrial processes of chlorination, alkylation, nitration, and esterification (chemical process flowsheets and uses).
4. Preliminary information on developments in organic chemical technology.

Inorganic Technology:

1. Chemical concept of method and technological principles with particular reference to inorganic processes.
2. Mineral and fuel resources.
3. Wet and dry methods of enrichment of minerals.
4. Coal processing core processes: combustion, gasification and degasification of coal, desulfurization of coal.
5. Production of synthesis gas.
6. Heterogenous catalysis.
7. Technology of sulfur compounds (sulfur combustion, oxidation of SO_2-SO_3, absorption of SO_3, sulfuric acid).
8. Technology of nitrogen compounds (ammonia synthesis, combustion of ammonia, absorption of nitrogen oxides, synthesis of urea, nitrogen fertilizers, nitric acid).
9. High pressure processes in gas and liquid phases.
10. Production of soda.
11. Industry of phosphorus and phosphate fertilizers.
12. Preliminary information on trends in the inorganic chemical technology.

Basic bibliography:

1. Jess Andreas, Chemical Technology: An Integral Textbook, Wiley 2013, ISBN13 (EAN): 9783527304462, ISBN10: 3527304460.
2. Moulijn Jacob A., Chemical Process Technology, Wiley-Blackwell 2013, ISBN13 (EAN): 9781444320251, ISBN10: 1444320254.
3. F. A. Henglein, Chemical Technology, Elsevier, 2013, ISBN 1483160254, 9781483160252.
4. Harold A. Wittcoff, Bryan G. Reuben, Jeffery S. Plotkin, Industrial Organic Chemicals, John Wiley & Sons, 2012, ISBN 1118229878, 9781118229873

Additional bibliography:

1. C.H. Bartholomew and R.J. Farrauto, Fundamentals of industrial catalytic processes, Wiley, Hoboken, New Jersey 2006.
2. M.B. Hocking, Handbook of chemical technology and pollution control, Elsevier, Amsterdam 2016.
3. G. Ertl, H. Knözinger, F. Schüth, J. Weitkamp, Handbook of heterogeneous catalysis, WILEY-VCH Weinheim 2008.
4. Laboratory materials

Result of average student's workload

Activity	Time (working hours)
1. Participation in lectures	60
2. Participation in laboratories	45
3. Participation in project	15
4. Preparation for the laboratories and project	35
5. Preparation for the exam and the exam	25

Student's workload

Source of workload	hours	ECTS
Total workload	180	7
Contact hours	128	5
Practical activities	52	2