COURSE DESCRIPTION CARD - SYLLABUS

Course name
New methods of organic compounds synthesis

Course

Field of study
Chemical Technology
Area of study (specialization)

Level of study
Second-cycle studies
Form of study
full-time

Year/Semester
1/1
Profile of study
general academic
Course offered in
Polish
Requirements
compulsory

Number of hours

Lecture
30
Laboratory classes
45
Other (e.g. online)

Tutorials
15
Projects/seminars
-

Number of credit points

5

Lecturers

Responsible for the course/lecturer:
dr hab. inż. Karolina Wieszczyck

Responsible for the course/lecturer:

Prerequisites

Structured, theoretically founded knowledge of organic chemistry including functional groups reactivity, reaction mechanisms characteristic for particular types of organic compounds.

Course objective

Providing students with extended and solid knowledge of organic chemistry in the field of modern synthesis methods, planning methods and selection of the most optimal methods of synthesis of selected groups of organic compounds.

1. To acquaint students with modern methods of organic synthesis, allowing the formation of new carbon-carbon and carbon-heteroatom bonds in molecules

2. To acquaint students with modern techniques of organic synthesis

2. Developing students' skills to solve basic problems in the field of one-stage synthesis of organic compounds, the ability to prepare a preparative recipe of a selected organic compound based on source literature using advanced laboratory techniques.

3. To familiarize students with the molecular modeling software used to analyze and evaluate the structural and physicochemical properties of simple and complex organic molecules

Course-related learning outcomes

Knowledge

Has expanded and in-depth knowledge in chemistry and other related areas of science, allowing to formulate and solve complex tasks related to chemical technology [K_W02]

Has knowledge of complex chemical processes, including the appropriate selection of materials, raw materials, methods, techniques, apparatus and equipment for carrying out chemical processes and characterizing the products obtained [K_W03]

Knows modern methods of testing the structure and properties of materials, necessary to characterize raw materials and products of the chemical and related industries [K_W07]

Has well-established and extended knowledge of the selected specialty [K_W11]

Skills

Has the ability to obtain and critically evaluate information from literature, databases and other sources and formulate opinions and reports on this basis [K_U01]

Has the ability to communicate with specialists and non-specialists in the field of chemical technology and related fields [K_U04]

Has the ability to professionally present research results in the form of a report, dissertation or presentation [K_U06]

Is able to use professional software, using them to design chemical processes [K_U07]

Is able to design and conduct chemical reactions on a laboratory scale in various conditions and properly use the results of these tests to scale up [K_U08]

Is able to critically analyze industrial chemical processes and introduce modifications and improvements in this area, using the acquired knowledge, including knowledge about the latest achievements of science and technology [K_U15]

Has the skills necessary to work in an industrial environment and in research teams [K_U18]

Knows and observes the safety rules related to the work performed [K_U19]

Can critically evaluate the results of experimental research and determine the direction of further research leading to the solution of problems in the field of technology and Eng. chem. [K_U21]

Has the ability to use the knowledge acquired under a specialty in professional activity [K_U23]

Social competences

Is aware of the need for lifelong learning and professional development [K_K1]

Professionally recognizes problems and makes the right choices related to the exercise of the profession, in accordance with the principles of professional ethics [K_K3]

Adheres to all teamwork rules; is aware of the responsibility for joint ventures and achievements in professional work [K_K4]

Is able to think and act in a creative and entrepreneurial way [K_K6]

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Lecture - evaluation of knowledge and skills acquired on the basis of a written exam (6 problem tasks based on the content of the lecture program).

Tutorials: - knowledge is verified during oral statements during classes and during tests in open questions. Correct chemical language explains issues and describes the latest ways to solve problems related to the synthesis of organic compounds

Laboratories (synthesis + modeling):

Synthesis - oral response before the preparation of the preparation, analyzing the manner of performing the planned synthesis (based on literature studies); assessment of the practical implementation of the synthesis of the desired product; evaluation of the report containing the analysis of literature research and discussion of the course and result of the organic compound synthesis (interpretation of the IR spectrum, 1H NMR).

Molecular modeling - final test

Method of verification of the acquisition of social competences: During the course, the student shows interest in expanding his knowledge and acquiring new skills, asks questions, actively participates in solving problems (observation by the teacher)

In the case of on-line classes, the verification of knowledge will be carried out in the same form on the eMeeting platform.

Programme content

Lecture:

Developing the basics in the field of reactivity of organic compounds, the direction of chemical reactions, the role of the catalyst, solvent, as well as in the field of stereochemical aspects of organic reactions.

Modern techniques of organic synthesis:

Reactions to form new carbon-carbon bonds in molecules (including Heck's reaction, Suzuki reaction, olefin metathesis, Michael's reaction)

New carbon-heteroatom bond formation reactions (e.g. Sharpless reaction, Mitsunobu reaction, Buchwald-Hartwig reaction)

Stereoselective reactions

Solid state synthesis

Microwave synthesis

Synthesis using phase transfer catalysis

Tutorials:

discussing in selected thematic blocks, with the active participation of students, selected types of modern chemical reactions: stereoselective condensation, reduction, synthesis using phase transfer catalysis, Heck, Suzuki, Buchwald-Hartwig reaction

Laboratories:

Preparation of preparations in the field of stereoselective condensation, reduction, synthesis using phase transfer catalysis, using a solid supported catalyst, biocatalysis. Conducting literature research on the methods of obtaining selected organic compounds. Preparation synthesis using professional equipment and advanced purification techniques.

Introduction of the basic principles of molecular modelling - spatial operation of models of molecules with specific structural parameters in two and three dimensions, basic techniques of molecular structure, modelling and measurement of structural parameters, building multifunctional molecules, minimizing the energy of a molecule or system of particles in a vacuum.

Teaching methods

Multimedia presentation (lectures, tutorials)

Scientific literature in the field of preparations (laboratories)

Bibliography

Basic

1. J.Clayden, N. Greeves, S. Warren , P. Wothers, Chemia organiczna, tom I, II i III, WNT, Warszawa 2009.

2. J. Gawroński, K. Gawrońska, K. Kacprzak, M. Kwit, Współczesna synteza organiczna, PWN, Warszawa 2004 C. Willis, M. Wills, Synteza organiczna, Wyd. Uniwersytetu Jagiellońskiego, Kraków 2004

3. M. Mąkosza, M. Fedoryński, Podstawy syntezy organicznej. Reakcje jonowe i rodnikowe, Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2006.

Additional

1. J. Skarżewski - Wprowadzenie do syntezy organicznej, PWN, Warszawa 1999

2. M.B. Smith, J. March, Advanced Organic Chemistry, Reaction, Mechanism and Structure, J.Wiley & Sons, New Jersey 2007.

3. A.I. Vogel, Preparatyka organiczna, WNT, Warszawa 2006.

Breakdown of average student's workload

	Hours	ECTS
Total workload	135	5
Classes requiring direct contact with the teacher	105	
Student's own work (literature studies, preparation for laboratory classes, preparation for tutorials, preparation for tests, preparation for exam) [1]	30	

[1] delete or add other activities as appropriate