

## LEARNING MODULE DESCRIPTION (SYLLABUS)

### ORGANIC CHEMISTRY

#### I. General information

1. Module title:  
**Organic chemistry**
2. Module code:  
**OCHE**
3. Module type:  
**compulsory**
4. Programme title:  
**Chemistry**
5. Cycle of studies:  
**second cycle of studies**
6. Year of studies:  
**First year**
7. Terms in which taught:  
**First - winter**
8. Type of classes and the number of contact hours  
**Lectures: 20 hrs; laboratory: 40 hrs; tutorials: 15 hrs.**
9. Number of ECTS credits:  
**7**
10. Name, surname, academic degree/title of the module lecturer/other teaching staff/ e-mail  
**Anna K. Przybył, dr. hab., Assoc. Prof., annaprz@amu.edu.pl;**  
**Donata Pluskota-Karwatka, dr. hab. Prof. UAM, Assoc. Prof., donatap@amu.edu.pl;**  
**Jakub Grajewski, PhD, kgraju@amu.edu.pl**  
**Michał Antoszczak, PhD, michant@amu.edu.pl**
11. Language of classes:  
**English**

#### II. Detailed information

1. Module aim (aims):

The main aim of this course is to provide students with the knowledge and skills needed in modern organic synthesis with regard to retrosynthetic analysis, including planning and modern techniques of synthesis. In addition, students will use spectroscopic methods (UV-vis, MS, FTIR, NMR) to analyze substrates and products obtained by them during experimental work.

Students will be trained in the following:

- Retrosynthetic analysis and planning of synthesis of chiral and complex compounds; reactions of selective formation of carbon-carbon and carbon-heteroatom bonds. Moreover, reactions and use of organometallic compounds in organic synthesis.
- Fundamental reactions involving sulphur and phosphorus compounds.
- Transfer of knowledge in the field of principles of planning of synthesis and application of spectroscopic methods to analysis of the obtained organic compounds
- Safety rules of work in laboratory of organic chemistry.

- Ability to use bases and literature sources and ability of writing reports of the experimental project, as well as prepare for proper interpretation of experimental results.

2. Pre-requisites in terms of knowledge, skills and social competences (where relevant)

**Advanced organic chemistry with modern methods of synthesis, spectroscopic analysis and application of this knowledge in experimental projects.**

3. Module learning outcomes in terms of knowledge, skills and social competences and their reference to programme learning outcomes

Learning outcomes symbol*	Upon completion of the course, students will:	Reference to programme learning outcomes#
OCHE_01	<b>know selected notions from advanced organic chemistry</b>	CHE2_W01, CHE2_W02, CHE2_W05; CHE2_W08, CHE2_U05 CHE2_K01
OCHE_02	<b>Know the synthetic principles of chosen name reactions and be able to critically analyse reaction mechanisms,</b>	CHE2_W01, CHE2_W02, CHE2_W03, CHE2_U01 CHE2_U02, CHE2_U08, CHE2_U09
OCHE_03	<b>be able to explain the use of compounds and reagents in organic synthesis</b>	CHE2_W01, CHE2_W05, CHE2_W06
OCHE_04	<b>be able to rationally plan syntheses of complex compounds and be able to discuss selected topics in organic chemistry</b>	CHE2_W01, CHE2_W02, CHE2_W05, CHE2_W07, CHE2_W08, CHE2_K01, CHE2_K02
OCHE_05	<b>be able to use literature sources and data bases</b>	CHE2_W01, CHE2_W08, CHE2_U09, CHE2_U10, CHE2_U11, CHE2_U13, CHE2_K02
OCHE_06	<b>Be able to plan and conduct the experimental work according to given procedure, timeframe and look after tidiness and safety of working area</b>	CHE2_W01, CHE2_W07, CHE2_U11, CHE2_U15, CHE2_K04
OCHE_07	<b>be able to apply the appropriate spectroscopic techniques (IR, UV-Vis, EI-MS and NMR) for the identification and characterization of organic compounds</b>	CHE2_W01, CHE2_W04, CHE2_W07, CHE2_U02, CHE2_U06, CHE2_U08, CHE2_U12, CHE2_U13, CHE2_U14 CHE2_K01, CHE2_K02
OCHE_08	<b>be able to prepare a written report concerning the conducted experiment, properties and spectroscopic analyzes of the obtained compound</b>	CHE2_W01, CHE2_W02, CHE2_W03, CHE2_W04, CHE2_U02, CHE2_U03, CHE2_U06, CHE2_U08, CHE2_U09, CHE2_U10, CHE2_U12, CHE2_U13, CHE2_U14 CHE2_K01, CHE2_K02
OCHE_09	<b>be able to evaluate the work contribution of themselves and other group members</b>	CHE2_U08, CHE2_U09, CHE2_U10, CHE2_U11, CHE2_U14, CHE2_U15, CHE2_K04
OCHE_10	<b>be able apply safety rules in the laboratory of organic chemistry</b>	CHE2_W07, CHE2_U15, CHE2_K03, CHE2_K04

\* module code, # programme learning outcomes  
01, 02... - learning outcome number

#### 4. Learning content

Learning content symbol	Learning content description	Reference to module learning outcomes
TK_01	<b>safety rules of work in the laboratory of organic chemistry</b>	OCHE_09, OCHE_10,
TK_02	<b>Introduction to the modern organic synthesis with strategies for analyzing organic reactions and electron pushing mechanisms.</b>	OCHE_01, OCHE_02, OCHE_05,
TK_03	<b>Chemistry of Carbonyl Compounds - formation and reactions of enols and enolates.</b>	OCHE_01, OCHE_02, OCHE_03, OCHE_05
TK_04	<b>Spectral analysis of organic compounds using: UV-Vis FTIR and Raman spectroscopy.</b>	OCHE_05, TK_07
TK_05	<b>Interpretation and analysis of organic compounds by MS and NMR spectroscopy methods</b>	OCHE_05, OCHE_08
TK_06	<b>Selective oxidation and reduction reactions</b>	OCHE_01, OCHE_02, OCHE_03, OCHE_04 OCHE_05,
TK_07	<b>Applications of phosphorus, sulfur and silicon chemistry: stereo- and regioselective synthesis of alkenes.</b>	OCHE_02, OCHE_03, OCHE_04 OCHE_05,
TK_08	<b>Pericyclic reactions: cycloadditions and rearrangements.</b>	OCHE_01, OCHE_03, OCHE_04 OCHE_05,
TK_09	<b>Organometallic reagents in controlling reactivity, regioselectivity and stereoselectivity.</b>	OCHE_01, OCHE_02, OCHE_03, OCHE_04 OCHE_05,
TK_10	<b>data analysis of the obtained products</b>	OCHE_05, OCHE_07, OCHE_08
TK_11	<b>Design of the synthesis of compounds, experimental synthesis of the planned products, interpretation of spectroscopic data and correct analysis with verification of the obtained compounds</b>	OCHE_05, OCHE_06, OCHE_07, OCHE_08, OCHE_09

#### 5. Reading list

- J. Clayden, N. Greeves, S. Warren, P. Wothers: *Organic Chemistry*. Oxford University Press, 2005 (selected paragraphs).
- F. A. Carey, R. J. Sundberg *Advanced Organic Chemistry Part B – Reactions and Synthesis*. 4<sup>th</sup> ed., Kluwer Academic Publishers, 2002 (selected paragraphs).
- J. March: *Advanced Organic Chemistry, Reactions, Mechanisms and Structure*. 6<sup>th</sup> ed., Wiley-VCH, 2007 (selected paragraphs).
- T. Laue, A. Plagens, *Named Organic Reactions*. Wiley, 2002 (selected paragraphs).
- K.C. Nicolaou, E.J. Sorensen: *Classics in Total Synthesis. Targets, Strategies, Methods*. 4<sup>th</sup> rep. Wiley-VCH, 2003 (selected paragraphs).
- S.D. Burke, R.H. Danheiser: *Oxidizing and reducing agents. Handbook of reagents for organic synthesis*. Wiley, 2000 (selected paragraphs).
- A.J. Pearson, W.R. Roush: *Activating agents and protective groups. Handbook of reagents for organic synthesis*. Wiley, 2001 (selected paragraphs).
- L.D. Field, S. Sternhell, J.R. Kalman: *Organic Structures from Spectra*. 3<sup>rd</sup> ed., Wiley, 2005.
- E. Pretsch, P. Bühlmann, C. Affolter: *Structure determination of organic compounds*. Springer 2000.
- The articles in the scientific journals recommended by lecturer and teaching staff.

#### 6. Information on where to find course materials

Website: <http://organa.home.amu.edu.pl>

#### III. Additional information

1. Reference of learning outcomes and learning content to teaching and learning methods and assessment methods

Lecture topic are closely related to laboratory exercises. Lectures provide the background and extensions for the labs.

Symbol of module learning outcome*	Symbol of module learning content##	Methods of teaching and learning	Assessment methods of LO achievement&&
OCHE_01	TK_02, TK_08	Lecture, practical class, pre-lab quizzes, laboratory work, laboratory reports	S- discussion and evaluation of the written report F- evaluation of practical skills P-written exam
OCHE_02	TK_01, TK_02, TK_10	Lecture, practical class, pre-lab quizzes, laboratory work, laboratory reports	S- discussion and evaluation of the written report F- evaluation of practical skills P-written exam
OCHE_03	TK_04 - TK_10	Lecture, practical class, pre-lab quizzes, laboratory work, laboratory reports	S- grading of quizzes, assessment of final exam; F- discussion, observation, evaluation of practical skills S-written exam
OCHE_04	TK_01, TK_02, TK_03, TK_06, TK_07, TK_08, TK_09, TK_10	Lectures, practical class, pre-lab quizzes, laboratory work, laboratory reports	S- grading of quizzes, assessment of final exam; F- discussion, observation, correction of laboratory work S- discussion and evaluation of the written report
OCHE_05	TK_02, TK_04, TK_05, TK_10	practical class, writing reports	S- discussion and evaluation of the written report S-written exam
OCHE_06	TK_01, TK_02, TK_10, TK_11	Lectures, practical class, pre-lab quizzes, laboratory work, laboratory reports	S- grading of quizzes F- discussion, observation, evaluation of practical skills, correction of laboratory work, S- discussion and evaluation of the written report
OCHE_07	TK_01, TK_02, TK_04, TK_05, TK_10, TK_11	Lectures, practical class, pre-lab quizzes, laboratory work, laboratory reports	S- grading of quizzes F- discussion, observation, evaluation of practical skills, correction of laboratory work, S- discussion and evaluation of the written report
OCHE_08	TK_02, TK_04, TK_05, TK_10, TK_11	Lectures, practical class, pre-lab quizzes, laboratory work, laboratory reports	S- grading of quizzes F- discussion, observation, evaluation of practical skills, correction of laboratory work, S- discussion and evaluation of the written report
OCHE_09	TK_01, TK_02, TK_10, TK_11	laboratory work, project reports	F- discussion, observation, correction of laboratory work, S- discussion and evaluation of the written report
OCHE_10	TK_01, TK_02, TK_03, TK_04, TK_05, TK_06, TK_07, TK_08, TK_09, TK_10	laboratory work, project reports	F- discussion, observation, correction of laboratory work, S- discussion and evaluation of the written report S - written exam;

\* e.g. KHT\_01 – module code as in Table in II.3 and II.4; # e.g. TK\_01 – learning content symbol as in II.4;

& Please include both formative (F) and summative (S) assessment

2. Student workload (ECTS credits)

Activity types	Mean number of hours* spent on each activity type
Contact hours with the teacher as specified in the programme	75
Preparation for laboratory #	35
Completion of laboratory reports	25
Preparation for exam	40
Total hours	175
Total ECTS credits for the module	7

\* Class hours – 1 hour means 45 minutes

#Independent study – examples of activity types: (1) preparation for classes, (2) data analysis, (3) library-based work, (4) writing a class report, etc.

### 3. Assessment criteria

#### Laboratories

Before starting the laboratory student should be familiar with the principles of occupational health and safety in the laboratory. This knowledge will be checked before first laboratory (formative assessment).

Before each laboratory the knowledge and skills concerning the current topic will be checked. To start the experiments a student should obtain at least **4 points (max 7 points)**. Additional **1 point** can be obtained for excellent performance of experiment (mainly assessment of student's skills), **2 point** for correctness of report and correct spectroscopic analyses of the compounds also including esthetics of the prepared report (**together 10 points for experiment**).

According to collected points students will receive:

- 5.0 66-70 pts;
- 4.5 61-65 pts;
- 4.0 54-60 pts;
- 3.5 46-53 pts;
- 3.0 37-45 pts.

#### Tutorials

At the last laboratory, beside of weekly test of knowledge and skills, students will solve **3 tests**, which cover the main topics raised on the previous tutorials. The questions will be given in the form of problems to be solved. Minimum 5.5 points must be obtained to pass the test (**maximum is 10**). The total points that can be obtained is **30 points**.

#### Lecture

The exam will be in written form. The final exam covers the lecture material and self-study assignments.

**Minimum 26** points must be obtained to pass the exam (**maximum is 50**). The final mark will base on points obtained on a written exam as well as on points collected on laboratories. Students will receive the final mark:

- 5.0 136 -150 pts;
- 4.5 126 -135 pts;
- 4.0 116 -125 pts;
- 3.5 96 -115 pts;
- 3.0 78 - 95 pts.