

Course description

Informing students on course requirements

Program: PhD full-time training, elective subject
Course: Synthetic methods of organic chemistry
Course code: AOKDI-ASZV-44
Academic year/Semester: 2025/26 2 nd semester
Educator and contact details (e-mail): Lajos Kovács, PhD; kovacs.lajos@med.u-szeged.hu
Type of course: <u>lecture</u> /seminar/practice/laboratory
Weekly hours of the course: 2
Credit value of the course: 2
Type of examination: final exam at the end of semester
Preliminary requirements (preliminary academic performance or completed course required to fulfill the purposes and requirements of the course): no specific requirements
Purpose of course: The aim of the course is to familiarize students with the role of organic chemical synthesis in the development of modern production methods, as well as in scientific research and the diagnostic and future therapeutic possibilities of drug research. During the course, students will learn about the role of basic concepts and the history of synthetic methods, and will also learn about the most important basic synthetic techniques necessary for the synthesis of various materials and their most fundamental applications in the order of their development.
Outcome requirements of the course (specific academic results to be established by the course): The expected requirement is that students develop theoretical proficiency in the main topics covered in the course, i.e., students should be able to understand the role of synthetic methods and the connections between historically known discoveries and the applications developed on the basis of these discoveries. Students should learn the theoretical background of the most basic synthetic techniques covered in the syllabus, from the simplest methods to stereoselective processes.
Topics: Basic concepts (chemical thermodynamics and kinetics, molecular structure and reaction mechanisms, stereochemistry). Elements of retrosynthetic analysis, the Lapworth-Evans model, consonant and dissonant relationships, synthons, donors and acceptors, skeletons and functional groups. Electron flow. Bond formation: carbon-carbon bonds with organometallic reagents, in base-catalyzed reactions (enolates) and acid-catalyzed reactions. Preparation of alkenes and alkynes. Pericyclic reactions. Formation of carbon-nitrogen bonds.

Aromatic electrophilic substitutions. Aromatic nucleophilic substitutions. Rearrangements. Reagents containing phosphorus, sulfur, selenium, silicon, and boron. Radical reactions. Reagents containing transition metals. Formation, removal, and interconversion of functional groups (substitution, addition, elimination, oxidation, reduction).

Heterocycles, synthesis of the most important five- and six-membered systems. Chemo- and regioselectivity.

Protective groups. Stereoselectivity, stereochemical control in cyclic and open-chain systems.

Syntheses from chiral precursors. Combinatorial and solid-phase syntheses (peptides, oligonucleotides). Computer-aided synthesis design.

Elements of graph theory, description of molecular complexity. The Ugi-Dugundji model.

Introduction to the most important computer programs. Selected syntheses. Literature on organic chemical syntheses, traditional and electronic sources.

Supporting methods to achieve learning outcomes: Teaching is supported by presentations in PDF format accessible to students, as well as lists of required and recommended reading.

Evaluation of the acquisition of expected learning outcomes:

Requirements: Attendance is mandatory for half of the course lectures; there is no opportunity to make up for missed classes. Absences will be considered excused if a medical certificate is presented.

Examination requirements: The semester ends with a written or oral colloquium exam based on the material covered in the lectures. The exam is graded on a five-point scale, and to achieve a grade of 2, i.e., a passing grade, students must demonstrate an understanding of the most basic concepts and their application. Achieving higher grades depends on the depth of understanding of non-basic knowledge and the ability to apply this knowledge to solve practical problems.

Mandatory reading list:

J.-H. Fuhrhop, G. Li (2003): Organic Synthesis. Concepts and Methods. VCH, Weinheim. ISBN: 978-3-527-30273-4.

Recommended reading list:

1. W. Carruthers (1992): Some modern methods of organic synthesis. 3rd ed. Cambridge University Press, Cambridge.

2. E. J. Corey, X.-M. Cheng (1989): The logic of chemical synthesis. John Wiley and Sons, New York.

3. I. Fleming (1973): Selected organic syntheses. A guidebook for organic chemists. John Wiley and Sons, London.

4. J. R. Hanson (2002): Organic synthetic methods. (Series Eds: E. W. Abel, A. G. Davies, D. Phillips, J. D. Woolins. Tutorial Chemistry Texts, 12.) Royal Society of Chemistry, Cambridge.

5. F. Serratosa, J. Xicart (1996): Organic chemistry in action. The design of organic synthesis. 2nd ed. (Studies in Organic Chemistry, 51.) Elsevier, Amsterdam.

6. C. Willis, M. Wills (1995): Organic synthesis. (Series Ed: S. G. Davies. Oxford Chemistry Primers, 31.) Oxford University Press, Oxford.

