

MODERNE METODE ORGANSKE SINTEZE

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Moderne metode organske sinteze
Course title:	Modern methods in organic synthesis
Članica nosilka/UL Member:	UL FKKT

Študijski programi in stopnja	Študijska smer	Letnik	Semestri	Izbirnost
Kemija, druga stopnja, magistrski	Ni členitve (študijski program)	1. letnik, 2. letnik		izbirni

Univerzitetna koda predmeta/University course code:	0072220
Koda učne enote na članici/UL Member course code:	K2I09

Predavanja /Lectures	Seminar /Seminar	Vaje /Tutorials	Klinične vaje /Clinical tutorials	Druge oblike študija /Other forms of study	Samostojno delo /Individual student work	ECTS
15	30	30 LV			75	5

Nosilec predmeta/Lecturer: izt. prof. dr. Uroš Grošelj

Vrsta predmeta/Course type: izbirni strokovni/Elective Professional

Jeziki/Languages:

Predavanja/Lectures:	Slovenščina
Vaje/Tutorial:	Slovenščina

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti: **Prerequisites:**

Študent oz. kandidat mora imeti predmet opredeljen kot študijsko obveznost.	The course has to be assigned to the student.
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Vsebina:

Uvod: Moderni trendi v organski sintezi. Klasična organska sinteza: kratek pregled, možnosti, omejitve in metode povečanja učinkovitosti.

Reagenti v organski sintezi. Tvorba C–C, C–H, C–X, C=C in C=X vezi v organski sintezi: pregled reagentov v metodah alkiliranja, olefiniranja, ariliranja, aciliranja, halogeniranja, hidroksiliranja, aminiranja, oksidacije in redukcije. Organo-S,Si,P,B reagenti. Organokovinski reagenti.

Načrtovanje organskih sintez. Retrosintezna analiza. Sintoni in sintezni ekvivalenti.

Kemoselektivnost in regioselektivnost. Pregled značilnih pravokotnih setov s primeri najpogosteje uporabljenih zaščitnih skupin.

Stereoselektivnost. Osnovni principi stereoselektivne in asimetrične sinteze.

Content (Syllabus outline):

Introduction: Modern trends in organic synthesis. Classical organic synthesis: survey, scope and limitations, methods for efficacy improvement.

Reagents in organic synthesis. Formation of C–C, C–H, C–X, C=C, and C=X bond in organic synthesis: survey on reagents for alkylation, olefination, arylation, acylation, halogenation, hydroxylation, amination, oxidations, and reductions. Organo-S,Si,P,B reagents. Organometallic reagents.

Planning organic syntheses. Retrosynthetic analysis. Synthons and synthetic equivalents.

Chemoselectivity and regioselectivity. Survey on typical orthogonal sets with examples of the most commonly used protecting groups.

Stereoselectivity: Basic principles of stereoselective and asymmetric synthesis. Stereoselective non-

<p>Stereoselektivne nekatalitske reakcije. Asimetrične katalitske reakcije in asimetrična organokataliza.</p> <p>Večkomponentne in tandemske (domino, kaskadne) reakcije.</p> <p>Principi kombinatorne sinteze. Kombinatorna sinteza na polimernih nosilcih. Tipični polimerni nosilci, distančniki in vezniki. Kombinatorna sinteza v raztopini. Reagenti in izolacijske tehnike pri kombinatorni sintezi v raztopini.</p> <p>Avtomatizacija laboratorijskih tehnik v organski sintezi. Izvedba in spremljanje</p>	<p>catalytic reactions. Asymmetric catalytic reactions, asymmetric organocatalysis.</p> <p>Multicomponent and tandem (domino, cascade) reactions.</p> <p>Principles of combinatorial synthesis: Solid-phase combinatorial synthesis. Typical polymer supports, linkers, and spacers. Solution-phase combinatorial synthesis. Reagents and isolation techniques in solution-phase combinatorial synthesis.</p> <p>Automation of laboratory techniques in organic synthesis . Reaction performing and monitoring. Isolation techniques. Compound characterisation.</p>
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Temeljna literatura in viri/Readings:

J. Clayden, N. Graves, S. Warren: *Organic Chemistry, 2nd Edition*, Oxford University Press, 2012, 1264 strani; ca. 15% (ca. 170 pages) and selected topics from synthetic organic chemistry (23, 24, 28, 32, 33, 41, 43).

Dodatna literatura / Supplementary Readings:

J.-H. Führhop, G. Li, *Organic Synthesis Concepts and Methods*, 3rd, completely revised and enlarged Edition, Wiley-VCH, Weinheim, 2003, 517 pages (selected topics).

W. Carruthers, I. Coldham, *Modern Methods of Organic Synthesis*, Cambridge University Press, Cambridge, 2004, 506 pages (selected topics).

Review articles covering selected topics on synthetic chemistry (recent papers published in the last decade).

Cilji in kompetence:

Cilji predmeta:

- poznavanje modernih pristopov k sintezi organskih spojin in sodobnih trendov na tem področju
- poznavanje principov stereoselektivne, asimetrične in kombinatorne sinteze
- poznavanje večkomponentnih in tandemskih reakcij ter 'klik' kemije in njihove uporabe v moderni organski sintezi
- poznavanje modernih eksperimentalnih metod, tehnik in reagentov v organski sintezi

Predmetno specifične kompetence:

- načrtovanje organskih sintez: kreiranje nabora možnih sinteznih poti in racionalna izbira najprimernejše poti,
- izbira ustreznih sinteznih metod in tehnik in izbira reagentov,
- načrtovanje in izvedba usmerjene oz. ciljne sinteze,
- načrtovanje in sinteza kombinatornih knjižnic

Objectives and competences:

Objectives:

- Knowledge on modern approaches in organic chemistry.
- Knowledge on principles of stereoselective, asymmetric, and combinatorial chemistry
- Knowledge on multicomponent and tandem reactions and 'click' chemistry and their application in modern organic synthesis
- Knowledge on modern experimental methods, techniques, and reagents in organic synthesis

Competences:

- Planning of organic syntheses: elaboration of possible synthetic routes and rational choice of the most suitable synthetic approach
- Choice of suitable synthetic methods, techniques, and reagents
- Planning directed and target syntheses
- Planning and synthesis of combinatorial libraries

Predvideni študijski rezultati:

Znanje in razumevanje

Znanje:

- klasične in moderne metode v organski sintezi
- načrtovanje in izvedba sintez organskih spojin

Razumevanje:

- splošnih principov moderne organske sinteze
- principov stereoselektivne, asimetrične in kombinatorne sinteze

Uporaba

Racionalno načrtovanje in praktična izvedba organskih sintez (usmerjene in ciljne sinteze organskih spojin in sinteze kombinatornih knjižnic).

Intended learning outcomes:

Knowledge and Comprehension

Knowledge:

- classical and modern methods in organic synthesis
- planning and performance of the syntheses of organic compounds

Comprehension:

- general principles of modern organic synthesis
- principles of stereoselective, asymmetric, and combinatorial synthesis

Application

Rational planning and practical performance of organic syntheses (directed and target synthesis of

<p>Refleksija Študent bo na osnovi pridobljenega znanja sposoben načrtovati sintezo enostavnih in kompliciranih organskih spojin in nato primerjati in kritično ovrednotiti možne sintezne poti. Na podlagi pridobljenega znanja se bo spodoben odločiti za najbolj racionalno sintezno pot in jo tudi preizkusiti v praksi.</p> <p>Prenosljive spretnosti</p> <ul style="list-style-type: none"> -Dostopanje do literaturnih virov -Zbiranje, interpretacija in kritično vrednotenje podatkov -Identifikacija in reševanje problemov -Poročanje (pisno in ustno) -Kritična analiza, sinteza 	<p>organic compounds and the synthesis of combinatorial libraries)</p> <p>Analysis On the basis of the acquired knowledge, the student is able to plan the synthesis of simple and complex organic compounds and to critically evaluate possible synthetic pathways. The student is able to choose and practically evaluate the most suitable (rational) synthetic approach.</p> <p>Skill-transference Ability</p> <ul style="list-style-type: none"> - access to and the use of literature sources - collection, interpretation, and critical data evaluation - identification and solving the problems - reporting and presentation of the results (oral and written) - critical analysis and synthesis
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Metode poučevanja in učenja:

Predavanja, seminarji in vaje

Learning and teaching methods:

Lectures, seminars, seminar projects, and laboratory trainings

Načini ocenjevanja:

Delež/Weight

Assessment:

Seminarska naloga	30,00 %	Seminar work
ustni izpit	70,00 %	oral exam
Ocene: 6-10 (pozitivno), 1-5 (negativno)		Grades: 6-10 (positive), 1-5 (negative)

Reference nosilca/Lecturer's references:

- Ciber, Luka, Ričko, Sebastijan, Gregorc, Jure, Požgan, Franc, Svete, Jurij, Brodnik Žugelj, Helena, Štefane, Bogdan, **Grošelj, Uroš**. Mechanistic insights into annulation of arylidene- Δ^2 -pyrrolin-4-ones by cinchona squaramide-based organocatalysts. *Advanced Synthesis & Catalysis*. **2022**, vol. 364, iss. 5, str. 980-993.
- Ciber, Luka, Gorenc, Ana, Hozjan, Mišel, Požgan, Franc, Svete, Jurij, Brodnik Žugelj, Helena, Štefane, Bogdan, **Grošelj, Uroš**. Enantioselective organocatalyzed functionalization of tetramic and tetrionic acids. *Advanced Synthesis & Catalysis*. **2022**, vol. 364, iss. 22, str. 3840-3855.
- Ričko, Sebastijan, Meden, Anže, Ciber, Luka, Štefane, Bogdan, Požgan, Franc, Svete, Jurij, **Grošelj, Uroš**. Construction of vicinal tetrasubstituted stereogenic centers via a Mannich-type organocatalyzed addition of Δ^2 -pyrrolin-4-ones to isatine imines. *Advanced Synthesis & Catalysis*, **2018**, vol. 360, iss. 6, str. 1072-1076.