UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	IZBRANA POGLAVJA IZ ORGANSKE KEMIJE
Course Title:	SELECTED TOPICS IN ORGANIC CHEMISTRY

Študijski program in stopnja Study Programme and Level	Študijska smer Study Field	Letnik Academic Year	Semester Semester
DR Kemijske znanosti, 3. stopnja	**/**	**1.**	**1. in 2.**
Doctoral programme in Chemical Sciences, 3rd Cycle	**/**	**1st**	**1st and 2nd**

Vrsta predmeta / Course Type: izbirni/Elective

Univerzitetna koda predmeta / University Course Code: KZ308

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Work	Druge oblike študija	Samost. delo Individual Work	ECTS
30	**30**	**/**	**/**	**30**	**60**	**5**

Nosilec predmeta / Lecturer: prof. dr. Janez Košmrlj / Dr. Janez Košmrlj, Full Professor

Jeziki / Languages:

Predavanja / Lectures:	**slovenski / Slovenian**
Vaje / Tutorial:	**slovenski / Slovenian**

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.

Vsebina:	Content (Syllabus outline):
Študent s soglasjem mentorja med spodaj navedenimi temami v izbere tiste, ki so najtesneje povezane z njegovim raziskovalnim delom. Nosilec predmeta in vodja študija poskrbita, da obseg študentovega dela ustreza 5 KT. Če je nosilcev več, izvajanje koordinira nosilec. - *Diazeni v organski sintezi.* Sinteze diazenov. Reakcije z alkeni in areni. Migracija halogena. Intramolekularne reakcije. Reakcije s karbonilnimi spojinami. Sinteze imidazolov, 1,2,4-triazolov in 1,3,4-oksadiazolov. Kemoselektivne oksidacije tiolov in selenolov; elektrokemijske lastnosti diazenov. Mitsunobijeve reakcije. Biokemijske	From the topics listed below the student selects (in agreement with the supervisor) those that are mostly related to his research work. The course coordinator, who is in charge of the course, and the leader of the study take care that the student's workload corresponds to 5 credits. If more persons are taking the study programme, the whole process is coordinated by course coordinator. - *Diazenes in organic synthesis.* Synthesis of diazenes. Reactions with alkenes and arenes. Halogen migration. Intramolecular reactions. Reactions with carbonyl compounds. Synthesis of imidazoles, 1,2,4-triazoles, and 1,3,4-oxadiazoles. Chemo selective oxidations of

karakteristike diazenov. 'Klik' kemija: 1,2,3-triazol, triazolijeve soli, triazolilideni, ligandi in kataliza. (prof. dr. Janez Košmrlj)
- *Moderne metode halogeniranja organskih molekul.* Vloga halosubstituiranih organskih molekul v (biološki) kemiji, biološko aktivne halosubstituirane molekule, biohalogeniranje, vpliv fluorovega atoma na biološko aktivnost molekul. Trajnostni razvoj in ekološko sprejemljive meode uvedbe halogenov. Razvoj novih tehnik za halogeniranje: brez topil, na vodi, prisotnost par topil, difuzijske membrane, mikroreaktorji, kontinuirni procesi. Novi reagenti za uvedbo halogenov v organske molekule, enantioselektivno halogeniranje, sinteze halosubstituiranih kiralnih sintonov. (izr. prof.dr.Marjan Jereb)
- *Izbrana poglavja iz selektivne sinteze.* Uporaba katalize s kovinami prehoda v organski sintezi. Načrtovanje kovinskih katalizatorjev. Katalizirane kaskadne reakcije. Selektivna tvorba enojne in dvojne C-C vezi katalizirana s kovinami prehoda. Reakcije spajanja: Heck, Suzuki, Negishi, Still, Sonogashira. Aktivacija inertnih C-H vezi. Selektivna funkcionalizacija C-H vezi s pomočjo uporabe usmerjajočih skupin. Uporaba rutenijevih katalizatorjev v selektivni tvorbi enojne $C(sp^2)$-$C(sp^2)$ in $C(sp^2)$-$C(sp^3)$ vezi. Kovinski alkilidenski (karbenski) kompleksi in tvorba C=C dvojne vezi. Križna metateza in metateza z zapiranjem obroča na alkenih in alkinih. Tvorba C-H vezi. Asimetrična redukcija ketonov. Sinteza in selektivnost 1,3-diketo-BF_2 kompleksov. (doc. dr. Franc Požgan, doc. dr. Bogdan Štefane).

thiols in selenols; electrochemical properties of diazenes. Mitsunobu reactions. Biochemical properties of diazenes. 'Click' chemistry: 1,2,3-triazole, triazolium salts, triazolylidenes, ligands and catalysis. (Prof. Janez Košmrlj)
- *Modern methods for halogenation of organic molecules.* Halosubstituted organic molecules in (biological) chemistry, biologically active halosubstituted molecules, biohalogenation, influence of fluorine atom on biological activity. Sustainability and ecologically acceptable halogenation methods. Modern halogenation methods: solvent-free conditions, halogenation in water, solvent vapors in solid state halogenations, diffusion membranes, micro reactors, continuous processes. New halogenation reagents, enantioselective halogenations, synthesis of halosubstituted chiral synthons. (Prof. Marjan Jereb).
- *Selected topics in selective synthesis.* The application of transition-metal catalysis in organic synthesis. The design of transition-metal catalysts. Catalysed cascade reactions. Selective formation of single end double C-C bonds via transition-metal catalysts. Coupling reactions: Suzuki, Heck, Negishi, Still, Sonogashira. Activation of inert C-H bonds. Selective functionalisation of C-H bonds driven by directing groups. The aplication of Ru-catalysts in selective formation of $C(sp^2)$-$C(sp^2)$ and $C(sp^2)$-$C(sp^3)$ bonds. The application of transition-metal alkylidene(carbene) complexes for C=C bond formation. Cross and ring-closing metathesis of alkene and alkyne substrates. The Formation of C-H bonds; asymmetric reduction of ketones. The synthesis and selectivity of 1,3-diketo-BF_2 complexes. (Prof. Franc Požgan, Prof. Bogdan Štefane).

Temeljna literatura in viri / Readings:

- Pregledni članki s področja diazenov. / Review articles on diazenes.
- (a) Organofluorine Chemistry, K. Uneyama, Blackwell, 2006, Oxford, UK.
(b) Modern Fluoroorganic Chemistry, P. Kirsch, Wiley-VCH, 2004, Weinheim, Germany.
(c) Fluorine in Organic Chemistry, R. D. Chambers, Blackwell, 2004, Oxford, UK.
(č) Green Reaction Media in Organic Synthesis, K. Mikami, Ed., Blackwell, 2005, Oxford, UK.
(d) Organic Reactions in Water, U. M. Lindström, Blackwell, 2007, Oxford, UK.

- (a) Asymmetric Synthesis, ed. R. A. Aitken and S. N. Kilenyi, Blackie Academic and Professional, London, 1994.
(b) B. L. Hayes, Microwave Synthesis: Chemistry at the Speed of Light, CEM Publishing, Matthews 2002.
(c) N. S. Isaacs, The Role of High Pressure Methods in Organic Chemistry, *Tetrahedron* 1991*, 47,* 8463-8497.
(d) F. Benito-Lopez, R. J. M. Egberink, D. N. Reinhoudt, W. Verboom, High pressure in organic chemistry on the way to miniaturization. *Tetrahedron* 2008*, 64,*10023-10040.
(e) K. Kranjc, M. Kočevar. From conventional reaction conditions to microwave-assisted catalytic transformations of various substrates. State of the art in 2012 (part A: general). *Curr.Org. Chem.* 2013, *17*, 448-456.
(f) K. Kranjc, M. Kočevar, From conventional reaction conditions to microwave-assisted catalytic transformations of various substrates. State of the art in 2012 (part B: catalysis). *Curr.Org. Chem.* 2013, *17*, 457-473.
(g) P. J. Kocienski, Protecting groups, Georg Thieme Verlag, Stuttgart, Corr. Ed. 2000.
(h) D. Alberico, M. E. Scott, and Mark Lautens, Aryl-Aryl Bond Formation by Transition-Metal-Catalyzed Direct Arylation, *Chem. Rev.*, 2007, *107* , 174–238.
(i) T. M. Trnka, R. H. Grubbs. The Development of L2X2RuCHR Olefin Metathesis Catalysts: An Organometallic Success Story. *Acc. Chem. Res.* 2001, *34*, 18-29.
- Članki iz tekoče lilterature / Articles from the current literature.

Cilji in kompetence:

Poglobljeno poznavanje izbranih področij organske kemije. Kandidat se seznani z modernimi metodami organske kemije, kar ga usposobi za samostojno reševanje problemov iz tega področja dejavnosti.

Objectives and Competences:

Advancing knowledge on selected topics and methods of organic chemistry, as a basis for practical problem solving in organic chemistry.

Predvideni študijski rezultati:

Znanje in razumevanje Študent spozna sodobno organsko kemijo, strukturne lastnosti organskih spojin, relacijo struktura-reaktivnost in sodobne organske pretvorbe.
Uporaba Študet se seznani z najsodobnejšimi in modernimi kemijskimi reakcijami in pretvorbami funkcionalnih skupin. Pripravi se za raziskovalno delo.
Refleksija Študent pridobi občutek za sodobne transformacije organskih spojin, ki jih je mogoče izvesti v laboratoriju.
Prenosljive spretnosti Izkušnje pri reševanju problemov, delo v skupinah, zbiranje in interpretacija rezultatov ter njihovo kritično vrednotenje.

Intended Learning Outcomes:

Knowledge and Comprehension Understanding advanced organic chemistry, knowledge on structural features of organic compounds, structure-reactivity relationship, and advanced organic transformations.
Application Student learns about the most advanced and state of the art chemical processes and functional group transformation. Student gets prepared for the research work.
Analysis Student learns advanced transformation of organic compounds that can be conducted in laboratory.
Skill-transference Ability Experiences in solving problems, team work, collection and interpretation of results and their critical evaluation.

Metode poučevanja in učenja:	**Learning and Teaching Methods:**
Predavanja in seminarji.	Lectures, seminars.

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
Ustni izpit	33 %	Oral examination
Seminar	33 %	Seminar assignment
Projekt	33 %	Project

Reference nosilca / Lecturer's references:

- SOMMER, Michael G., KURELJAK, Petra, URANKAR, Damijana, SCHWEINFURTH, David, STOJANOVIĆ, Nikolina, BUBRIN, Martina, GAZVODA, Martin, OSMAK, Maja, SARKAR, Biprajit, KOŠMRLJ, Janez, Chemistry, 2014, 20, 17296.
- BOLJE, Aljoša, KOŠMRLJ, Janez, Organic letters, 2013, 15, 5084.
- KOŠMRLJ, Janez, KOČEVAR, Marijan, POLANC, Slovenko, Synlett, 2009, 2217.