University of Zagreb

1. GENERAL INFORMATION				
1.1 Course teacher	Assoc. Prof. Tatjana Gazivoda Kraljević, PhD Prof. Marijana Hranjec, PhD		1.6 Year of the study	2 (3rd semester)
1.2 Name of the course	Modern Methods of Organic Synthesis		1.7 ECTS credits	5
1.3 Associate teachers	Ivana Sokol, mag. appl. chem.		1.8 Type of instruction (number of hours L + E + S + e-learning)	Total 60 (L:30, E:30, S:0)
1.4 Study programme (undergraduate, graduate, integrated)	graduate		1.9 Expected enrolment in the course	10
1.5. Status of the course	☐ mandatory	☒ elective	1.10 Level of application of e-learning (level 1, 2, 3), percentage of online instruction (max. 20%)	3

2. COUSE DESCRIPTION	
2.1. Course objectives	To familiarize students with the principles of modern synthetic methods and their application in research and industry, planning synthesis and retrosynthetic analysis of organic molecules, and developing critical thinking in selecting the most appropriate synthetic pathways for organic synthesis in the laboratory.
2.2. Enrolment requirements and/or entry competences required for the course	
2.3. Learning outcomes at the level of the programme to which the course contributes	• Compile and apply advanced knowledge of natural and technical sciences, particularly chemical engineering and environmental engineering in solving scientific, professional and general social problems. • Solve engineering problems using the scientific method combining expert knowledge from chemistry, environmental, and chemical engineering as well as material science and engineering. • Plan and independently perform experiments in order to confirm a hypothesis to estimate economic and ecological efficiency of processes. • Utilise advanced laboratory procedures and instruments for synthesis of new products, create sustainable processes, and solve problems of water, air and soil pollution. • Identify and discuss advantages, disadvantages and limitations of certain methods for preparation, synthesis, analysis and processing of samples in accordance with sustainable development and life cycle of products and processes. • Independently organise and plan timelines, apply a general methodology for project planning and management in a business environment • Create a critical analysis, evaluation and interpretation of personal results, and compare them with existing data in scientific and expert literature • Investigate and analyse implementation of innovative and incoming chemical technologies in multidisciplinary environment • Demonstrate independence and reliability in independent work, as well as effectiveness, reliability and adaptability in team work

	• Outline results of independent and teamwork in a written and oral form to non-experts and experts in a clear and coherent way. • Develop work ethic, personal responsibility and tendency for further skill and knowledge acquisition, according to standards of engineering practice		
2.4. Expected learning outcomes at the level of the course (3 to 10 learning outcomes)	1. to define the principles and problems related to simple and multistage organic synthesis 2. to analyze by using the retrosynthetic approach the structure of the target molecules and to explain, propose and present possible synthetic pathways 3. to select and propose the most suitable synthetic route for the synthesis of target molecules with respect to the available starting reagents 4. to explain and apply the principles of assisted microwave assisted, organometallic, domino and multicomponent reactions in a modern approach to organic synthesis 5. to synthesize selected target molecules using modern synthetic methods		
2.5. Course content (syllabus)	**WEEK 1.** Introduction. Organic Synthesis Strategies: planning of synthesis and control. Retrosynthesis. **WEEK 2.** Chemoselectivity, regioselectivity and stereoselectivity of choosen reaczions of organic synthesis. **WEEK 3.** Formation of carbon–carbon single bonds **WEEK 4.** Formation of carbon–carbon double bonds. Synthesis of double bonds with defines stereochemistry. **WEEK 5.** Pericyclic reactions. Functionalization of alkenes. **WEEK 6.** Oxidation and reduction reactions. **WEEK 7.** PARTIAL EXAM **WEEK 8.** Asymmetric synthesis with natural products as initial reactants. Asymmetric catalysis: creating C-C, C-H, C-O and C-N bonds. Enzymes: biological methods in asymmetric synthesis and bioorganometallic reactions. **WEEK 9.** Microwave application in the synthesis of different classes of organic compounds. Theory of microwave synthesis and microwaves. Microwave reactors for organic synthesis. **WEEK 10.** Microwave synthesis techniques as part of green chemistry. Microwave assisted scale-up of organic synthesis. **WEEK 11.** Application of organometallic cross-linking reactions in modern organic synthesis. **WEEK 12.** Domino reaction as one of the strategies of modern organic synthesis: cationic, anionic and enzymatic. **WEEK 13.** Multicomponent reaction in liquid and solid state. **WEEK 14.** Application of flow chemistry in the synthesis of heterocycles, biologically active compounds and natural products. **WEEK 15.** PARTIAL EXAM Work assignment		
2.6. Format of instruction:	☒ lectures ☐ seminars and workshops ☒ exercises ☐ online in entirety ☒ partial e-learning ☐ field work	☐ independent assignments ☐ multimedia and the internet ☒ laboratory ☐ work with mentor ☐ (other)	2.7. Comments:
2.8. Student responsibilities			