University of Zagreb

1. GENERAL INFORMATION				
1.1. Course teacher	Prof. Matko Erceg, PhD Prof. Nataša Stipanelov Vrandečić, PhD		1.6. Year of the study	1st year (2nd semester)
1.2. Name of the course	Product Life Cycle Assessment		1.7. ECTS credits	5
1.3. Associate teachers			1.8. Type of instruction (number of hours L + E + S + e-learning)	Total: 60 (L30, E0, S30)
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%)	2

2. COUSE DESCRIPTION	
2.1. Course objectives	Provide a comprehensive understanding of the life cycle assessment (LCA) as a standardized ecological tool to compare different products and processes with regard to their impact on the environment.
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. • Correlate expert knowledge from chemistry, chemical engineering and material engineering with awareness of influence on society, economy and environment. • Plan and independently perform experiments in order to confirm a hypothesis to estimate economic and ecological efficiency of processes. • Optimise complete and sustainable technological processes using analysis and modelling aimed at waste minimization utilising the strategy of the closed cycle manufacturing. • Apply tools, methods and standards for monitoring and assessing the quality of processes and products, as well as their environmental impact, and to predict potential risks in working with technological processes and developing products. • 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. • Evaluate technological processes and products from the perspective of high functionality in different conditions and environmental effects.

	• Create a critical analysis, evaluation and interpretation of personal results, and compare them with existing data in scientific and expert literature • 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. Explain and correlate concepts of sustainable development and environmental policy 2. Define laws and regulations related to the environmental protection 3. Discuss multiple approaches to product life cycle assessment 4. Construct and outline a simple project concerning the environment protection 5. Apply computer applications in the field of LCA method 6.Apply critical thinking skills in the evaluation of the results of LCA methods.
2.5. Course content (syllabus)	**WEEK 1.** The environment: environmental systems, sources of pollution, anthropogenic pollution, the consequences of environmental pollution (ecological boomerang). **WEEK 2.** Sustainable development and environmental policy. **WEEK 3.** The legal system of environmental engineering in the world and Croatia. **WEEK 4.** Environmental Management: concept and mission. Environmental Management Systems, ISO 14001. **WEEK 5.** The life cycle approach: Life Cycle Thinking (LCT), Life Cycle Initiative (LCI), Life Cycle Assessment (LCA), Life Cycle Management (LCM). **WEEK 6.** Discussion on the previous subjects. Conclusions. Standardization of the life cycle assessment: ISO 14040 and ISO 14044. **WEEK 7.** Partial exam **WEEK 8.** The structure of LCA method (Part 1). **WEEK 9.** The structure of LCA method (Part 2). **WEEK 10.** Computer program (software) for the LCA analysis - LCA analysis on selected examples (Part 1) **WEEK 11.** Computer program (software) for the LCA analysis - LCA analysis on selected examples (Part 2). **WEEK 12.** The advantages and disadvantages of the LCA approach. Selected examples. **WEEK 13.** Application areas of the LCA: design for the environment, improvement of products (technology), strategic planning, marketing, lowering costs. **WEEK 14.** Knowledge management in the environmental engineering - mission of the educational system in the environmental engineering. **WEEK 15.** Partial exam

	SEMINAR: The seminar will be used for further analysis and discussion following lectures. Students will also receive individual and group tasks (projects) that will solve and present at the seminar.									
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	Attending lectures and seminars in the amount of 80% of the total hourly rate. Individual and group assignments (projects) and their presentation. Active participation during lessons.									
2.9. Monitoring student work	Class attendance	YES		Research	YES		Oral exam	YES		
	Experimental work		NO	Report	YES		(other)			
	Essay		NO	Seminar paper	YES		(other)			
	Preliminary exam	YES		Practical work		NO	(other)			
	Project	YES		Written exam	YES		ECTS credits (total)	5		

2.10. Required literature (available in the library and/or via other media)	**Title**	**Number of copies in the library**	**Availability via other media**
	J. Guinee, Handbook on Life Cycle Assessment: Operational Guide to ISO Standards, Kluwer Academic Publishers, New York, 2002.	1	
	H. Wenzel, M. Hauschild, L. Alting, Environmental Assessment of Products, Volume ½, Kluwer Academic Publishers, New York, 2002.	1	
2.11. Optional literature	Environmental management standards (The ISO 14000 family of standards), Quality management system standards (The ISO 9000 family of standards), scientific and technical papers of the subject area.		
2.12. Other (as the proposer wishes to add)			