University of Zagreb

1. GENERAL INFORMATION				
1.1 Course teacher	Prof. Zlata Hrnjak-Murgić, PhD		1.6 Year of the study	1 (1st semester)
1.2 Name of the course	Polymer Materials Engineering		1.7 ECTS credits	5
1.3 Associate teachers	Zvonimir Katančić, PhD		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%)	2

2. COUSE DESCRIPTION	
2.1 Course objectives	The aim of the course is to introduce students to the processes and technologies of synthesis / polymer production and application of polymer materials. Polymer synthesis processes are: condensation /step-growth, addition /free-radical, ionic, atom transfer. Also to inform them about the classification of polymer materials according to their properties, types of materials and their application, and to introduce them to polymer waste management / recycling. Students are training for the independent work in the laboratory for synthesis and monitoring of the technological process production, training to understand and identify the problems regarding the relationship structure-properties-application. Understanding the molecular structure of synthetic and natural polymers and their applications.
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. • 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. • Independently organise and plan timelines, apply a general methodology for project planning and management in a business environment. • 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. • Demonstrate independence and reliability in independent work, as well as effectiveness, reliability and adaptability in teamwork. • Outline results of independent and teamwork in a written and oral form to non-experts and experts in a clear and coherent way. • Communicate with the scientific and professional community, as well as society in general in local and international surroundings • 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. Apply of knowledge about polymerization processes: chemical reactions, mechanisms and media 2. Apply of knowledge about technological processes for the preparation / synthesis of polymer materials 3. Apply of analysis techniques for monitoring the process during its implementation 4. Acquire Knowledge about; structure – properties relationship and application of polymer materials 5. Define biopolymers and synthetic polymers / polymer materials 6. Acquire knowledge about the most used synthetic polymer materials: plastics, rubber, composites 7. Define the technological processes of recycling polymer materials
2.5. Course content (syllabus)	**WEEK 1.** Introduction to polymer chemistry, nomenclature of polymers. **WEEK 2.** Polymerization reactions by mechanism - free-radical chain growth **WEEK 3.** Polymerization reactions by mechanism - step-growth chain growth **WEEK 4.** Polymerization reactions by media type - in suspension, - in emulsion **WEEK 5.** Modification of polymers - copolymerizations **WEEK 6.** Modification of polymers - atom transfer radical polymerizations **WEEK 7.** Modification of polymers – in situ polymerization (polymer blends / (nano)composites) **WEEK 8.** Partial exam **WEEK 9.** Introduction; classification of polymer materials, synthetic polymers: definition, types of polymer materials **WEEK 10.** Synthetic Polymers: structure – properties / application **WEEK 11.** The most significant polymers: plastics (technological processes of synthesis, properties, application) **WEEK 12.** Most Important polymers: rubber (technological processes of synthesis, properties, application) **WEEK 13.** Biopolymers (technological processes of production, properties, application) **WEEK 14.** Introduction to waste management / recycling / sustainable development **WEEK 15.** Partial exam

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	Attendance and active participation in lectures. Independent analysis of lab results and writing exercise reports								
2.9. Monitoring student work	Class attendance	YES		Research		NO	Oral exam		NO
	Experimental work	YES		Report	YES		(other)		
	Essay		NO	Seminar paper		NO	(other)		
	Preliminary exam	YES		Practical work	YES		(other)		
	Project		NO	Written exam	YES		ECTS credits (total)	5	

	Title	Number of copies in the library	Availability via other media
2.10. Required literature (available in the library and/or via other media)	Course materials prepared by the course teachers for lectures, seminars and laboratory exercise.		www.fkit.unizg.hr
	Joel R. Fried, Polymer Science and Technology, Prentice Hall Professional, USA, 2003.	2	
	L.A. Utracki: Polymer Alloys and Blends, Hanser Publishers, New York, 1989.	1	
	A. L. Andrady, «*Plastics and the Enviroment*», J.Wiley & Sons, Hoboken, New Jersey, 2003.	2	
2.11. Optional literature	A. Azapagic, A. Emsley, I. Hamerton "*Polymers, the Enviromental and Sustanible Development*" J. Wiley & Sons, N.Y. 2003.		
2.12. Other (as the proposer wishes to add)	H. Mark, N. Bikales, C. Overberger, G. Menges, Encyclopedia of Polymer Science and Engineering, John Wiley & Sons, New York, Vol. 1-17, 1985-1989.		