Załącznik nr 1 do zarządzenia nr 11 Rektora UW z dnia 19 lutego 2010 r.
w sprawie opisu przedmiotu w Uniwersyteckim Katalogu Przedmiotów zamieszczonym
w Uniwersyteckim Systemie Obsługi Studiów (USOS)
i zgodnym ze standardami Europejskiego Systemu Transferu i Akumulacji Punktów (ECTS)

Formularz opisu przedmiotu (formularz sylabusa) – dotyczy studiów I i II stopnia

A. Informacje ogólne (wypełnia koordynator przedmiotu z wyjątkiem pól *Kod przedmiotu*, *Przyporządkowanie do grupy przedmiotów*).

Nazwa pola	
Course title	Kinetics and mechanism of polyreactions
Faculty/Institute	Faculty of Chemistry /Department of Chemical Technology
Programme for which the course is offered	
Course ID	
Erasmus code	13304
Course group	
Didactic cycle	2M/4M
Type/form of class	Lecture 30 h/semester
Brief course description	Thermodynamics of polymerization reactions. Basic mechanism of polyreactions. Reactivity of vinyl monomers in polymerization. Mechanisms of polymerization. Elementary reactions in step and chain polymerization: initiation, propagation, termination, transfer of the chain, kinetic equations, inhibition and retardation. Copolymerization kinetic models: reactivity ratios and methods of their determination. Controlled/living radical polymerization. Coordination polymerization: most used catalysts, stereoregular polymers. Polycondensation. Polyaddition. Polymerization methods in industry: bulk polymerization, solution polymerization, suspension and emulsion polymerization. Other polymerization methods in industry
Full course description	Topics of the lecture: 1. Thermodynamics of polymerization reactions 1.1. Enthlpy and entropy of polymerization reaction 2. Polymerizability of double bonds 2.1. Influence of substituents on double bond reactivity 2.2. Electron effects 2.3. Steric effects 3. Nomenclature of polymers 4. Mechanisms of polymerization 4.1. Step and chain polymerization 5. Radical polymerization 5.1. Initiators in radical polymerization 5.2. Kinetic equations 5.2.1. Initiation 5.2.2. Propagation 5.2.3. Termination (chain length and kinetic chain length) 5.2.4. Transfer reaction, 5.2.5. Inhibition and retardation 6. Copolymerization in radical polymerization 6.1. Copolymerization kinetics models 6.2. Terminal model 6.3. Penultimate model 6.4. Reactivity ratios and methods of their determination 7. Characteristics of controlled/living radical polymerization 7.1. Nitroxide mediated radical polimerization (NMRP) 7.1.1. I generation radical mediators 7.1.2. II generation radical mediators 7.1.3. Bimolecular mechanism of NMRP 7.1.4. Monomolecular mechanism of NMRP 7.1.5. Polymerization ”outside-in” and ”inside-out” 7.2. Atom transfer radical polymerization (ATRP) 7.3. Reversible addition-fragmentation chain transfer polymerization (RAFT) 7.4. Classical vs. controlled radical polymerization 7.5. Other polymerization models 8. Ionic polymerization – historical background 9. Anionic polymerization - living polymerization 9.1. Initiators for anionic polymerization 9.2. Active centers and polymerization conditions 9.3. Kinetics of reaction 9.3.1. Elementary reactions i anionic polymerization

		10. Cationic polymerization 11. Pseudo-anionic polymerization 11.1. Initiators in cationic polymerization 11.2. Active centers and polymerization conditions 11.3. Kinetics of reaction 11.4. Elementary reactions in cationic polymerization 12. Coordination polymerization 12.1. Stereoregular polymers 12.2. Characteristics of catalysts In stereospecific polymerization 12.3. Zieglera-Natty catalysts 12.4. Mono- and bimolecular mechanism 12.5. Metallocene Katalizatory 12.6. Industrial stereoregular polymers 13. Step-growth polymerization 14. Polycondensation 14.1. Polyamides, polyesters and epoxy resins 15. Polyaddition 16. Polyurethanes 17. Thermosetting resins 18. Industrial polymerization methods 18.1. Bulk polymerization in bulk 18.2. Solvent polymerization 18.3. Suspension and emulsion polymerization 18.4. Other methods of polymerization
Prerquisites	Formal prerquisites	Licentiate in chemistry
	other prerquisites	Before the course the student should: – demonstrate basic knowledge of polymer chemistry, – demonstrate skills in scientific literature search and study – demonstrate understanding principles of research work in chemistry – demonstrate understanding relations between experiment and conclusions – demonstrate skills in understanding scientific papers in English
Learning outcomes		After the course the student should: – demonstrate skills in forecasting possible methods of synthesis for given polymers – is able to determine conditions for planned synthesis of given polymer - - - demonstrate skills in analysis of applicability of a given polymer and its relations with the method of synthesis – demonstrate skills to understand scientific papers in English
ECTS credits		3 weeks of work (and presence at the lecture) is sufficient to get 3 ECTS points
Assessment methods and criteria		Exam
Type of examination		Skills sufficient to pass the exam. To proof the acquired skills the student is obligated to answer questions connected to the main topics of the lecture. Passing the exam means to get > 50% of max. number of points There are approximately 6 open questions of varying difficulty expressed in points of a settled scale (scale 0-20 pts).
Type of course		According to the program of the study the lecture is an optional course in the Ist year of the 2nd level (M) specially for those who use polymer materials or/and polymer chemistry methods during specialization
Mode of delivery		Multimedia aided lecture. Stimulation to active participation (questions, discussion, digressions to research and scientific problems)
Language of instruction		Polish
Bibliography		Supplementary bibliography: - „Chemia polimerów", tom I,II,III, praca zbiorowa pod red. Z. Florjańczyka i S. Penczka, Oficyna Wyd. Pol. Warszawskiej, 1995-98. - Nicholson J. W., Chemia polimerów WNT, Warszawa 1996. - G. Odian, Principles of Polymerization, John Wiley & Sons, 2004 - G. Moad, D.H. Solomon, The Chemistry of Free Radical Polymerization Pergamon, 1995
Work placement(s)		Lecture room
Course coordinator		dr hab. Inż. Andrzej Kaim
Academic teachers		dr hab. Inż. Andrzej Kaim
Remarks		

B. Informacje szczegółowe (wypełnia prowadzący zajęcia, z wyjątkiem pól: *Limit miejsc w grupie, Terminy odbywania zajęć*, *Miejsce odbywania zajęć* – pola te prowadzący zajęcia wypełnia w porozumieniu z administracją).

Nazwa pola	

Name of the academic teacher	**Andrzej Kaim**
Academic degree	PhD, Ing.
Form of the class	Lecture
Learning outcomes	After the course the student should: – demonstrate skills in forecasting possible methods of synthesis for given polymers – is able to determine conditions for planned synthesis of given polymer - - - demonstrate skills in analysis of applicability of a given polymer and its relations with the method of synthesis
Assessment methods and criteria for this course	Skills sufficient to pass the exam. To proof the acquired skills the student is obligated to answer questions connected to the main topics of the lecture. Passing the exam means to get > 50% of max. number of points There are approximately 6 open questions of varying difficulty expressed in points of a settled scale (scale 0-20 pts).
Type of examination	Written exam
A list of topics	1. Thermodynamics of polymerization reactions 1.1. Enthlpy and entropy of polymerization reaction 2. Polymerizability of double bonds 2.1. Influence of substituents on double bond reactivity 2.2. Electron effects 2.3. Steric effects 3. Nomenclature of polymers 4. Mechanisms of polymerization 4.1. Step and chain polymerization 5. Radical polymerization 5.1. Initiators in radical polymerization 5.2. Kinetic equations 5.2.1. Initiation 5.2.2. Propagation 5.2.3. Termination (chain length and kinetic chain length) 5.2.4. Transfer reaction, 5.2.5. Inhibition and retardation 6. Copolymerization in radical polymerization 6.1. Copolymerization kinetics models 6.2. Terminal model 6.3. Penultimate model 6.4. Reactivity ratios and methods of their determination 7. Characteristics of controlled/living radical polymerization 7.1. Nitroxide mediated radical polimerization (NMRP) 7.1.1. I generation radical mediators 7.1.2. II generation radical mediators 7.1.3. Bimolecular mechanism of NMRP 7.1.4. Monomolecular mechanism of NMRP 7.1.5. Polymerization ”outside-in” and ”inside-out” 7.2. Atom transfer radical polymerization (ATRP) 7.3. Reversible addition-fragmentation chain transfer polymerization (RAFT) 7.4. Classical vs. controlled radical polymerization 7.5. Other polymerization models 8. Ionic polymerization – historical background 9. Anionic polymerization - living polymerization 9.1. Initiators for anionic polymerization 9.2. Active centers and polymerization conditions 9.3. Kinetics of reaction 9.3.1. Elementary reactions i anionic polymerization 10. Cationic polymerization 11. Pseudo-anionic polymerization 11.1. Initiators in cationic polymerization 11.2. Active centers and polymerization conditions 11.3. Kinetics of reaction 11.4. Elementary reactions in cationic polymerization 12. Coordination polymerization 12.1. Stereoregular polymers 12.2. Characteristics of catalysts In stereospecific polymerization 12.3. Zieglera-Natty catalysts 12.4. Mono- and bimolecular mechanism 12.5. Metallocene Katalizatory 12.6. Industrial stereoregular polymers 13. Step-growth polymerization 14. Polycondensation 14.1. Polyamides, polyesters and epoxy resins 15. Polyaddition 16. Polyurethanes

	17. Thermosetting resins 18. Industrial polymerization methods 18.1. Bulk polymerization in bulk 18.2. Solvent polymerization 18.3. Suspension and emulsion polymerization Other methods of polymerization
Learning activities and teaching methods	Multimedia aided lecture. Stimulation to active participation (questions, discussion, digressions to research and scientific problems)
Bibliography	Supplementary bibliography: - „Chemia polimerów", tom I,II,III, praca zbiorowa pod red. Z. Florjańczyka i S. Penczka, Oficyna Wyd. Pol. Warszawskiej, 1995-98. - Nicholson J. W., Chemia polimerów WNT, Warszawa 1996. - G. Odian, Principles of Polymerization, John Wiley & Sons, 2004 - G. Moad, D.H. Solomon, The Chemistry of Free Radical Polymerization Pergamon, 1995
Limit of places available	
Time	
Place	