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	Physicochemistry of polymers
Faculty/Institute	Faculty of Chemistry /Department of Chemical Technology
Programme for which the course is offered	
Course ID	
Erasmus code	13303
Course group	
Didactic cycle	1M
Type/form of class	Lecture 15 h/semester
Brief course description	Polymers-characteristics and classification of organic synthetic polymers. Basic methods of polymer investigations. Macromolecule chain in vaccum, solution and in solid-state. Main parameters describing polymer materials (molecular mass, polydispersity index, crystallinity and more) Microstructure of organic synthetic polymers, relation between chemical structure of polymer and its physical properties. Chemical and reological properties of polymers. Influence of polymerization method and properties of polymeric material. Chemical and physical methods of properties modification Thermodynamics of polymerization reactions. Polymeric matrix, fillers and composites. Transformation of polymer into polymer materials. Relation between formulation methods and physicochemical properties of polymeric materials.
Full course description	Topics of the lecture: 1. Introduction 1.1. Definition of polymer , examples 1.2. Production capacity in Poland and in the world 1.3. Classification of polymers, criteria of classification: origin, architecture of chain, chemical formula, stereochemistry of polymer chain, application. 2. Characteristics of polymers and investigation methods 3. Basic investigations 3.1. Chemical formula 3.1.1. Homopolymer 3.1.2. Copolymer 3.1.3. Terpolymer 3.2. Molecular mass and its distribution 3.3. Stereochemistry 3.3.1. Geometric isomerie 3.3.2. Configuration (atactic, izotactic, syndiotactic) 3.4. Topology 3.4.1. Chains 3.4.2. Branches 3.4.3. Nets 4. Investigation of functional properties 4.1. Mechanical properties (tensile modulus, stress-strain, modulus of elasticity, shear modulus, compression modulus, mechanical fatigue modulus) 4.2. Thermal properties (thermal conductivity, isolation, heat and flame resistance) 4.3. Reology (visco-elastic behaviour) 4.4. Electric (conductivity) 4.5. Trybology (friction and sliding) 4.6. Resistance to environmental, biological and chemical impact 4.7. Polymer processing (thermal processing, chemical and thermosetting) 4.8. Case study: the Challenger space shuttle catastrophe. 5. Synthetic polymer chain in: 5.1. Space (main parameters: chain flexibility, radius of gyration, contour length of the polymer chain, persistence length, the end-to-end mean square distance of a polymer chain, deviations from model values) 5.2. Solvent (polymer ball as result of polymer-polymer and polymer-

		solvent interactions, dilute and concentrated polymer solution, excluded volume parameter for polymer-solvent systems, theta solvent, theta (θ) conditions, concept of blobs by de Gennes, models of polymer solution (Flory-Huggins, Scatchard-Hildebrand) thermodynamic of the solution, viscosity measurement (Mark-Houwink-Sakurada equation) 5.3. Solid-state, polymer morphology, polymer cyistallinity (amorphous region, fibrils and spherulites) 6. Polymer chain structure vs. its properties 6.1. Physical properties: monomer structure, size of substituents, steric factors, branches and crosslinked networks, bond order, tangled chains, configuration, molecular weight and its distribution (ebulioscopic and cryoscopic parameters, gas and membrane osmosis, light scattering, sedimentation, Mη, Mw, Mz,) 6.2. Chemical properties 6.3. Reological parameters (temperature dependence of viscoelastic modulus), crystallinity vs. amorphinity - glass transition temperature 6.4. Modification of polymer characteristics (thermo-and duroplastic polymers) 7. Transformation of polymer into polymeric material (additives: reinforcing, fillers, modifiers, preparation, plasticizers, colorants, stabilizers, crosslinkers, porophors) 8. Polymer processing (injection, molding, RRIM, extrusion, blown film extrusion, pressing, spinning: melt, dry, and wet, polymer expanding foam. 9. Polymer composites (matrix, fillers, filler-matrix interface)
Prerquisites	Formal prerquisites	Licentiate in chemistry
	other prerquisites	Before the course the student should: – demonstrate basic knowledge of polymer chemistry, - demonstrate skills in understanding character of scientific activity in chemistry – demonstrate skills in scientific literature search and study 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
ECTS credits		3 weeks of work (and presence at the lecture) is sufficient to get 3 ECTS points
Assessment methods and criteria		Exam. 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		Skills required to pass the exam: 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.
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. – H. Galina, Fizykochemia polimerów, Oficyna Wydawnicza Politechniki Rzeszowskiej, 1998. – T. Broniewski, J. Kapko, W. Płaczek, J. Thomalla, „Metody i ocena własności tworzyw sztucznych”, WNT, Warszawa 2000. – J. W. Nicholson, Chemia polimerów”, WNT, Warszawa 1996. – Jan F. Rabek, „Współczesna wiedza o polimerach” PWN 2008 – Publisher: Wiley-Interscience – Wł. Przygocki, A. Włochowicz, „Fizyka polimerów”, PWN 2001 – Irma Gruin, „Materiały polimerowe”, PWN 2003 – Fizykochemia polimerów. Wybrane zagadnienia, D. Ciesielska, K. Kelar, Wydawca: Wydawnictwo Politechniki Poznańskiej, 1997:http://www.wbc.poznan.pl/dlibra/docmetadata?id=1753&from=&dirids=1.
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	Exam. 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	Skills required to pass the exam: 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.
A list of topics	1. Introduction 1.1. Definition of polymer , examples 1.2. Production capacity in Poland and in the world 1.3. Classification of polymers, criteria of classification: origin, architecture of chain, chemical formula, stereochemistry of polymer chain, application. 2. Characteristics of polymers and investigation methods 3. Basic investigations 3.1. Chemical formula 3.1.1. Homopolymer 3.1.2. Copolymer 3.1.3. Terpolymer 3.2. Molecular mass and its distribution 3.3. Stereochemistry 3.3.1. Geometric isomerie 3.3.2. Configuration (atactic, izotactic, syndiotactic) 3.4. Topology 3.4.1. Chains 3.4.2. Branches 3.4.3. Nets 4. Investigation of functional properties 4.1. Mechanical properties (tensile modulus, stress-strain, modulus of elasticity, shear modulus, compression modulus, mechanical fatigue modulus) 4.2. Thermal properties (thermal conductivity, isolation, heat and flame resistance) 4.3. Reology (visco-elastic behaviour) 4.4. Electric (conductivity) 4.5. Trybology (friction and sliding) 4.6. Resistance to environmental, biological and chemical impact 4.7. Polymer processing (thermal processing, chemical and thermosetting) 4.8. Case study: the Challenger space shuttle catastrophe. 5. Synthetic polymer chain in: 5.1. Space (main parameters: chain flexibility, radius of gyration, contour length of the polymer chain, persistence length, the end-to-end mean square distance of a polymer chain, deviations from model values) 5.2. Solvent (polymer ball as result of polymer-polymer and polymer-solvent interactions, dilute and concentrated polymer solution, excluded volume parameter for polymer-solvent systems, theta solvent, theta (θ) conditions, concept of blobs by de Gennes, models of polymer solution (Flory-Huggins, Scatchard-Hildebrand) thermodynamic of the solution, viscosity measurement (Mark-Houwink-Sakurada equation) 5.3. Solid-state, polymer morphology, polymer cyistallinity (amorphous region, fibrils and spherulites) 6. Polymer chain structure vs. its properties

	6.1. Physical properties: monomer structure, size of substituents, steric factors, branches and crosslinked networks, bond order, tangled chains, configuration, molecular weight and its distribution (ebulioscopic and cryoscopic parameters, gas and membrane osmosis, light scattering, sedimentation, Mn, Mw, Mz,) 6.2. Chemical properties 6.3. Reological parameters (temperature dependence of viscoelastic modulus), crystallinity vs. amorphinity - glass transition temperature 6.4. Modification of polymer characteristics (thermo-and duroplastic polymers) 7. Transformation of polymer into polymeric material (additives: reinforcing, fillers, modifiers, preparation, plasticizers, colorants, stabilizers, crosslinkers, porophors) 8. Polymer processing (injection, molding, RRIM, extrusion, blown film extrusion, pressing, spinning: melt, dry, and wet, polymer expanding foam. 9. Polymer composites (matrix, fillers, filler-matrix interface)
Learning activities and teaching methods	Multimedia aided lecture. Stimulation to active participation (questions, discussion, digressions to research and scientific problems)
Bibliography	– „Chemia polimerów", tom I,II,III, praca zbiorowa pod red. Z. Florjańczyka i S. Penczka, Oficyna Wyd. Pol. Warszawskiej, 1995-98. – H. Galina, Fizykochemia polimerów, Oficyna Wydawnicza Politechniki Rzeszowskiej, 1998. – T. Broniewski, J. Kapko, W. Płaczek, J. Thomalla, „Metody i ocena własności tworzyw sztucznych", WNT, Warszawa 2000. – J. W. Nicholson, Chemia polimerów", WNT, Warszawa 1996. – Jan F. Rabek, „Współczesna wiedza o polimerach" PWN 2008 – Publisher: Wiley-Interscience – Wł. Przygocki, A. Włochowicz, „Fizyka polimerów", PWN 2001 – Irma Gruin, „Materiały polimerowe", PWN 2003 – Fizykochemia polimerów. Wybrane zagadnienia, D. Ciesielska, K. Kelar, Wydawca: Wydawnictwo Politechniki Poznańskiej, 1997:http://www.wbc.poznan.pl/dlibra/docmetadata?id=1753&from=&dirids=1.
Limit of places available	
Time	
Place	