COURSE DESCRIPTION CARD - SYLLABUS

Course name
Polymer chemistry [S2TCh2-TP>CP]

Course

Field of study
Chemical Technology

Year/Semester
1/1

Area of study (specialization)
Polymer Technology

Profile of study
general academic

Level of study
second-cycle

Course offered in
Polish

Form of study
full-time

Requirements
compulsory

Number of hours

Lecture
30

Laboratory classes
45

Other
0

Tutorials
0

Projects/seminars
0

Number of credit points

6,00

Coordinators

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Lecturers

Prerequisites

Student starting this subject should have knowledge of the basic principles of general, organic, physical chemistry, and chemical engineering, as well as subjects taught at “Chemical technology - polymeric materials". Student knows and applies good practices of laboratory work, is able to operate the scientific equipment as well as is able to search for information in scientific literature, databases and other properly chosen sources.

Course objective

Gaining basic knowledge of the chemistry of chain and step polymerization processes, modern methods of controlled polymerization, chemical reactions of polymers, as well as gaining skills related to methods of synthesis, modification, degradation of polymers and basic methods of analysis of plastics.

Course-related learning outcomes

Knowledge:
Student has expanded and well-established knowledge in the field of polymer chemistry and other related areas of science, allowing to formulate and solve complex tasks related to polymer technology (K_W2). Student has expanded knowledge in the field of kinetics, thermodynamics, catalysis of

polymerization processes (K_W4). Student has a well-established and expanded knowledge of methods and mechanisms of polymer synthesis and modification (K_W11). Student has established knowledge of occupational health and safety in the polymer chemistry laboratory (lists and applies health and safety regulations) (K_W10).

Skills:
Student has the ability to obtain and critically evaluate information from literature and other sources (K_U1). Student works in a group to prepare and perform experiments in the laboratory (K_U2). Student has the ability to present the results of laboratory exercises in a concise and proper manner (K_U6). Student has the ability to analyze and interpreting of the results of experiments from the area of polymer chemistry. (K_U21). The student has the ability to use the knowledge acquired under the specialty in a professional career (K_U23). Student knows and obeys the safety rules related to the work performed (K_U19).

Social competences:
Student is conscious of limitations of science and technology in the area of polymer chemistry, including environment protection (K_K2). Student is conscious of limitation of his knowledge and understands the need of further continuous education in area of polymer chemistry (K_K1). Students can work in a team and are aware of their responsibility for their work and responsibility for the results of the teamwork (K_K4).

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Lecture. Stationary form: A written exam (consisting of 4 - 6 open questions) from the area of polymer chemistry presented during the lectures (student obtains a pass by achieving at least 51% of points). Online form: A test consisting of 20 - 30 questions (including >50% closed questions) from the area of polymer chemistry presented during the lectures (student obtains a pass by achieving at least 51% of points) on the eKursy platform.
Laboratory classes. Stationary form. Establishing a final grade on the basis of partial grades obtained during the semester: oral answers or written tests from the material included in the exercises and the given theoretical issues; the presence and performance of all laboratory exercises provided for in the study program; activity in the classroom and the way of exercise performance; grades from reports prepared after each exercise. Online form: Establishing a final grade on the basis of partial grades obtained during the semester; an oral answer and / or a written test (test, 10-20 closed questions) from the material contained in the exercises, instructional videos, and the theoretical issues provided, conducted in "live view" mode with the web camera on, in direct contact with the teacher via the platform eKursy; online presence and completion of all laboratory exercises provided in the study program; assessment of the reports prepared after each exercise and sent via the eKursy platform or by e-mail using the university's e-mail system.

Programme content

Issues related to chemistry of chain and step polymerization processes, modern methods of controlled polymerization, chemical reactions of polymers, as well as related to methods of synthesis, modification, degradation of polymers and basic methods of analysis of plastics.

Course topics

The lecture covers the following topics:
1. Chain growth polymerization:
Thermodynamics of polymerization (polymerization-depolymerization equilibrium).
Mechanism and kinetics of radical polymerization of difunctional monomers (linear polymerization) and multifunctional monomers (cross-linked polymerization). Controlled ("living") radical polymerization: ATRP, SFRP, RAFT. Copolymerization.
Mechanism and kinetics of anionic and cationic polymerization. Living ionic polymerization.
Coordination polymerization: process characteristics, catalysts, mechanisms, kinetics.
Polymerization by metathesis (ROMP, ADMET).
2. Step growth polymerization:
Thiol-ene polymerization: monomers, mechanisms, kinetics.

Polycondensation: polycondensation control, kinetics and mechanism of linear polycondensation (stoichiometric, non-stoichiometric, in the presence of monofunctional compounds), stoichiometric and non-stoichiometric polycondensation of multifunctional monomers, gel point, Flory's distribution.
3. Highly branched polymers.
4. Chemical reactions of polymers, degradation and stabilization of polymers.
Solving problem tasks based on theoretical issues discussed during lectures.
The laboratory classes covers the following issues:
Reactions leading to a reduction in the molecular weight of the polymer. Preparation of light-curing varnishes by photopolymerization and methods for testing the properties of painting materials and coatings. Theoretical basics of the polycondensation process (reaction mechanism, chemistry and polycondensation methods, properties and application of condensation polymers). Basic methods for identification of plastics (thermal decomposition, solubility, color reactions, elemental analysis, determination of characteristic numbers, determination of water, spectroscopic methods). Chemical reactions leading to polymer modification. Copolymerization (process kinetics, reactivity factors, types of copolymers).
1. Depolymerization on the example of PMMA and PS.
2. Preparation of light-cured varnishes and investigating its properties.
3. Polyesterification kinetics.
4. Polymer identification.
5. Chemical modification of polymers - obtaining cellulose triacetate.
6. Copolymerization of styrene with maleic anhydride.

Teaching methods

Lecture: informative lecture with multimedia presentation.
Laboratory classes: performing experiments and getting acquainted with research equipment and chemical reagents used in their conduct, teaching materials for the laboratory in pdf files, tutorial videos on the eKursy platform.

Bibliography

Basic:
1. Chemia polimerów, J. Pielichowski, A. Puszyński , TEZA, Kraków, 2004
2. Chemia polimerów tom I, Praca zbiorowa pod red. Z. Floriańczyka i S. Penczka , Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa , 1995

Additional:
1. Principles of Polymerization, 4-th edition, G. Odian , Wiley-Intersciene:Hoboken, New York, 2004
2. Principles of Polymer Chemistry, 2-nd edition, A.Ravve, Kluver Academic/Plenum Publishers, New York, 2000
3. Handbook of radical polymerization, K. Matyjaszewski, T.P. Dawis, Wiley Interscience, 2002

Breakdown of average student's workload

	Hours	ECTS
Total workload	150	6,00
Classes requiring direct contact with the teacher	79	3,00
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	71	3,00