COURSE DESCRIPTION CARD - SYLLABUS

Course name
Technology of polymeric materials [S1TCh2E>TMP]

Course

Field of study
Chemical Technology

Year/Semester
3/5

Area of study (specialization)
–

Profile of study
general academic

Level of study
first-cycle

Course offered in
English

Form of study
full-time

Requirements
compulsory

Number of hours

Lecture
30

Laboratory classes
30

Other
0

Tutorials
0

Projects/seminars
0

Number of credit points

5,00

Coordinators

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Lecturers

Prerequisites

The student should have a basic knowledge of organic and general chemistry. Student should also be able to search information from literature, databases and other properly selected sources and be willing to cooperate as part of a team.

Course objective

Providing knowledge in the field of preparation, structure, properties and applications of polymers and polymeric materials. Mastering the skills of polymer synthesis, plastic processing and characteristics of their physicochemical properties.

Course-related learning outcomes

Knowledge:
1. The student has a systematic, theoretically founded general knowledge in the field of polymer chemistry, in particular their structure and methods of obtaining polymers [K_W08]
2. The student has the necessary knowledge in the field of synthetic and natural polymers as well as knows the technological methods for processing plastics [K_W09]
3. The student has the necessary knowledge in the field of research methods to identify and

characterize the physicochemical properties of polymer materials [K_W11]

Skills:
1. Student has the skills to search information from literature, databases and other sources related to polymeric materials [K_U01]
2. Student uses basic laboratory techniques in the synthesis of polymeric materials [K_U20]
3. Student is able to characterize the chemical, physical and mechanical properties of polymers and plastics [K_U22]

Social competences:
1. The student understands the need for further training and improving their professional competences [K_K01]
2. The student is able to work in a group and cooperate during performing practical tasks [K_K03]
3. The student is aware of the importance of the effects of engineering activities related to the plastics industry, in particular the impact on the environment [K_K02]

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Lectures:
Knowledge acquired in lecture is verified in the form of a written exam after the end of the lecture cycle. The exam consists of 30-40 test questions and 5-10 open questions. Passing threshold: 50% of points. Exam issues will be sent to students via e-mail using the university e-mail system.
In the case of remote lectures, the exam will be held on-line using the university infrastructure.
Laboratory:
The skills in the laboratory classes are verified on the basis of a test of theoretical issues, consisting of 3-5 questions. Theoretical issues for all exercises are passed on during the organizational meeting. Passing threshold: 50% of points. In addition, reports containing a description of the experiment and calculations are evaluated.

Programme content

Issue related to technology of polymeric materials.

Course topics

1. Basic concepts in the polymers science (monomer, polymer, mer, degree of polymerization, functionality). Nomenclature of polymers. Polymer classification according to Flory and Carothers.
2. Properties and applications of selected polymers, eg. polyolefins, vinyl polymers, rubbers, polyesters, polyamides, polycarbonates, polyurethanes, epoxy and polyester resins, special polymers.
3. Chain polymerization - mechanism and types. Chain polymerization stages - initiation, propagation and termination. Radical, cationic, anionic polymerization, living polymerization. The influence of monomer structure on the polymerization mechanism. Polymerization kinetics, autocatalytic accelerations (gel effect). Copolymerization, types of copolymers, properties and application.
4. Coordination polymerization: types of catalysts, Ziegler-Natta catalysts, polymerization mechanism, specificity of the process (specific properties of formed polymers).
5. Industrial polymerization methods (bulk, suspension, in solution, emulsion, phase boundary).
6. Step polymerization. Polycondensation and types of polycondensation. Comparison of polymerization and polycondensation. Polycondensation reactions. Kinetics of the polycondensation process - equilibrium and non-equilibrium polycondensation, bifunctional and multifunctional polycondensation, Carothers equation. Polyaddition - mechanism, properties, examples of polymers obtained by polyaddition.
7. Industrial methods of polycondensation (in alloy, in solution, on the interface, in the solid phase).
8. Crosslinking of polymers: crosslinking methods, examples, vulcanization.
9. Basic concepts of the polymer structure. Shapes of polymer chains (linear, branched, crosslinked). Tacticity. Crystalline and amorphous polymers - properties. Polymer structure and physicochemical properties. Molecular weight of polymers and polydispersion. Processes affrcting molecular weight - degradation, depolymerization and destruction.
10. Plastics - definitions, classifications. Plastomers, elastomers, thermoplastics, duroplasts.
11. Basic mechanical and thermal properties of polymers.

12. Basic methods of plastic processing - technological stages, extrusion, injection molding, pressing, thermoforming, calendering, spinning, rotomolding.
13. Recykling of plastic - material recykling, compounds recovery and energy recovery.
As part of the laboratory classes, the following exercises are performed:
1. Polymerization - block polymerization of methyl methacrylate.
2. Polycondensation - synthesis of polyamide 6,10 at the interface.
3. Synthesis of polyvinyl butyral.
4. Polyaddition - obtaining of polyurethane foam.
5. Processing of polymeric materials - extrusion techniques.
6. Processing of polymer materials - injection molding.

Teaching methods

1. Lecture: multimedia presentation
2. Laboratory: practical classes using chemical reagents and research equipment

Bibliography

Basic:
1. Z. Floriańczyk, S. Penczek, Chemia Polimerów, t.I , Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2001
2. W. Szlezyngier, Tworzywa sztuczne, Oficyna Wydawnicza Politechniki Rzeszowskiej, Rzeszów 1996
3. J. Pielichowski, A. Puszyński, Technologia tworzyw sztucznych, WNT, Warszawa 2003
4. J. Pielichowski, A. Puszyński, Chemia polimerów, TEZA, Kraków 2004
5. J.F. Rabek, Współczesna wiedza o polimerach, PWN, Warszawa 2008
6. B. Łączyński, Tworzywa wielkocząsteczkowe: rodzaje i własności, WNT, Warszawa 1982.

Additional:
1. I. Gruin, Materiały polimerowe, PWN, Warszawa 2003
2. D. Żuchowska, Polimery konstrukcyjne, WNT, Warszawa 2000
3. K. Czaja, Poliolefiny, WNT, Warszawa 2005

Breakdown of average student's workload

	Hours	ECTS
Total workload	125	5,00
Classes requiring direct contact with the teacher	64	2,50
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	61	2,50