COURSE DESCRIPTION CARD - SYLLABUS

Course name

Polymers and polymer composites

Course

Field of study

Chemical Technology

Year/Semester

I/1

Area of study (specialization)

Composites and Nanomaterials

Profile of study

general academic

Level of study

First-cycle studies

Course offered in

English

Form of study

full-time

Requirements

compulsory

Number of hours

Lecture

15

Laboratory classes

15

Other (e.g. online)

Tutorials

Projects/seminars

Number of credit points

3

Lecturers

Responsible for the course/lecturer:

Piotr Gajewski, Eng, PhD

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Responsible for the course/lecturer:

Prerequisites

Student should have knowledge of the basic principles of general chemistry, organic chemistry, physical chemistry, polymer chemistry and polymer technology. Knows and applies the techniques of good work in the chemical laboratory, can use basic laboratory equipment. Is able to obtain information from literature, databases and other properly selected sources.

Course objective

Obtaining knowledge about polymers, polymer materials, their preparation, methods of production, properties and applications.

To familiarize students with the chemistry of chain and step polymerization processes, chemical reactions of polymers, as well as obtain skills related to the methods of synthesis, modification, degradation of polymers and polymer composites. To familiarize students with the properties, applications and basic methods of plastics analysis.

Course-related learning outcomes

Knowledge

Student has expanded and in-depth 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 synthesis and modification of polymers. (K_W11). Student has an established knowledge of 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). He works in a group to prepare and perform experiments in the laboratory (K_U2). Student has the ability of presenting the results of laboratory exercises in concise and proper manner (K_U6). Student has the ability of analysing and interpreting of the results of experiments from the area of polymer chemistry and technology (K_U21). Can use English in professional contacts (K_U3). Student knows and observes the safety rules related to the performed work (K_U19).

Social competences

Student is conscious of limitations of science and technology in the area of polymer chemistry and technology, 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 and technology (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. Written exam consisting of 4-5 questions regarding the issues presented in the lecture (student pass the exam by reaching at least 51% of points).

Labolatory. The grade consists of: obligatory performance of all laboratory exercises included in the program, positive grades from all exercises (tests consisting of 3 to 5 questions), activity during lab classes and preparation of reports on performed experiments.

Programme content

The lecture covers the following topics:

Classification of polymer materials. Chain polymerization: thermodynamics, mechanism and types, copolymerization. Polycondensation: mechanism and types. Polymer blends. Special and engineering polymers. Polymer structure and properties: morflology, thermal and mechanical properties.

The laboratory covers the following issues:
Basic concepts (linear, branched and crosslinked polymers, molecular weight, tacticity). Basic characteristics of chain polymerization reaction: types, mechanisms, examples of polymers. Copolymerization and copolymers. Basic characteristics of step polymerization; mechanism, examples of polymers. Polymer morphology. Classification of polymeric materials (thermoplastics, thermosets, elastomers, thermoplastic elastomers). Polymer blends. Engineering and performance polymers. Thermal properties of polymers (thermal transitions, DSC measurements). Mechanical properties of polymers (tensile properties, stress-strain failure, viscoelasticity, rheological models).

The laboratory covers the following issues:

1 Radical copolymerization of styrene with maleic anhydride.

2 Thermal transitions in polymers measured by differential scanning calorimetry (DSC).

3 Morphology of crystalline polymers.

Teaching methods

Lecture: informative lecture with multimedia presentation.

Laboratory: performing experiments and refer to research equipment and chemical reagents used.

Bibliography

Basic

1. G. Odian, Principles of Polymerization, 4th ed., Wiley, 2004.
2. H.R. Allcock, F.W. Lampe Contemporary Polymer Chemistry, 2nd ed., Prentice Hall, 1990.
3. L.H. Sperling Introduction to Physical Polymer Science, 4th ed., Wiley, 2006.
4. Handbook of Plastics Technologies, C.A. Harper. Ed., The McGraw-Hill Companies, 2006, e-book

Additional

1. S. Fakirov Fudamentals of Polymer Science for Engineers, Wiley, 2017
2. M. Rubinstein, R. H. Colby Polymer Physics, Oxford, 2003
3. R. A. Pethrick Polymer Science and Technology for Scientists and Enginineers, Whittless Publishing, 2010
4. J. W. Nicholson The Chemistry of Polymers, 5th ed., Royal Society of Chemistry, 2017

Breakdown of average student's workload

	Hours	ECTS
Total workload	75	3,0
Classes requiring direct contact with the teacher	40	1,6
Student's own work (literature studies, preparation for laboratory classes/tutorials, preparation for tests/exam, project preparation) [1]	35	1,4

[1] delete or add other activities as appropriate