COURSE DESCRIPTION CARD - SYLLABUS

Course name
Technologies of production and modification of polymers [S2TCh2-TP>TPiMP]

Course

Field of study
Chemical Technology

Year/Semester
1/2

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 (e.g. online)
0

Tutorials
0

Projects/seminars
30

Number of credit points

8,00

Coordinators

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Lecturers

Prerequisites

Student starting this subject should have knowledge of the basic principles of general, organic including polymer chemistry, physical chemistry, and chemical engineering. 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

To introduce students to the technology of polymer production, methods of their modification, as well as properties, processing and areas of application of polymeric materials. Students acquire skills related to polymer synthesis, polymer modification and plastic analysis methods.

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). The student has a well-established and expanded knowledge of the techniques of industrial polymer synthesis and modification of polymer properties during synthesis (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 and technology. (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 test consisting of 20 - 30 questions (including >50% closed questions) from the area of polymer technology 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 technology 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.
Projects. Stationary and online form: Determining the final grade on the basis of partial grades received during the semester: preparation for current classes - performing the next stage of project work on the basis of multimedia presentations of individual stages of the project in the selected field of polymer technology, activity during classes, the ability to solve the problems posed and the method of presenting the results obtained - passing the completed project. Stationary conducted in direct contact with the teacher, and online conducted in "live view" mode with the web camera on, in direct contact with the teacher via the platform eKursy.

Programme content

The lecture covers the following topics:
Historical outline of polymer chemistry and technology.
Areas of application of polymeric materials.
Carbochemical and petrochemical raw materials for the production of polymers and plastics.
Industrial methods of carrying out of polyreactions, physicochemical basics, apparatus, industrial installations. Polymer isolation and purification processes. Preparation of polymers for processing.
Overview of technological installations for the production of polymers obtained by chain polymerization, as well as the properties, processing methods and directions of application of the obtained polymers: polyolefins (polyethylene, polypropylene, polyisobutylene, polydienes), polystyrene, poly(vinyl chloride), polytetrafluoroethylene, poly(vinyl acetate), poly(vinyl alcohol), polyvinyl acetals, acrylic polymers (polymethacrylates, polyacrylonitrile, polyacrylamide), polyoxomethylene.
Overview of technological installations for the production of polymers obtained by step polymerization,

as well as the properties, processing methods, and directions of application of the obtained polymers: polyamides (aliphatic, aromatic), polyesters (aliphatic, aliphatic-aromatic, aromatic), polycarbonates, unsaturated polyester resins, alkyd resins, formaldehyde resins, epoxy resins, polyurethanes, polysiloxanes.
Chemical modification (copolymerization, e.g. of olefins, styrene, vinyl chloride, tetrafluoroethylene, polymer reactions) and physical modification of polymers (e.g. fillers, plasticizers, blowing agents).
The latest achievements in the field of polymer material technology and their technical applications.
Applications of polymeric materials in various fields of technology (e.g. polymers in the construction of vehicles, aircraft, space technology, information recording, medicine, medical technology, etc.).
The laboratory classes covers the following issues:
Polymer composites. Structure, properties, forming methods, application of laminated materials. Types of binders, reinforcing materials, release agents used to obtain laminates. Radical polymerization (reaction mechanism, kinetics, technical methods of polymerization). Step polymerization (mechanism and kinetics of the reaction, technical methods of conducting polycondensation). Temperatures of phase transitions in polymers. Physicochemical basis of polymer modification.
1. Polymer composites - obtaining and testing the properties of polyester laminates.
2. Synthesis of gliptal resin modified by linseed oil.
3. Synthesis and study of the properties of PA 6.6.
4. Synthesis of poly(methyl methacrylate) by emulsion method.
The project covers the following issues:
Preparation of the project of a chosen plastic product, including a selection of the appropriate polymer, polymer production method (polymer production technology), processing method (presentation of the product production line with quality control) as well as directions of post-production and post-use waste management.

Teaching methods

Lecture: informative lecture with multimedia presentation.
Laboratory classes: performing experiments and getting acquainted with research equipment and chemical reagents used in their conduc, teaching materials for the laboratory in pdf files, tutorial videos on the eKursy platform.
Project: project method. Performing individual stages of the project using computer work, preparing multimedia presentations.

Bibliography

Basic:
1. W. Szlezyngier, Tworzywa sztuczne, FOSZE Rzeszów 1998.
2. J. Pielichowski, A. Puszyński, Technologia tworzyw sztucznych, WNT Warszawa 1994.

Additional:
1. Z. Wirpsza, Technologia ogólna polimerów, Politechnika Radomska 1997.
2. Praca zbiorowa (red. Z. Florjańczyk, S. Penczek), Chemia polimerów, t. II, III Oficyna Wydawnicza Politechniki Warszawskiej. Warszawa 2002.
3. Ullmann's Encyclopedia of Industrial Chemistry, Wiley VCH
4. Kirk-Othmer Encyclopedia of Chemical Technology, john Wiley and Sons, Inc, 2000

Breakdown of average student's workload

	Hours	ECTS
Total workload	200	8,00
Classes requiring direct contact with the teacher	109	4,50
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	91	3,50