COURSE DESCRIPTION CARD - SYLLABUS

Course name
Composites, nanomaterials and special materials [S2TCh2-TP>K_NiTS]

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
15

Laboratory classes
0

Other
0

Tutorials
0

Projects/seminars
15

Number of credit points

2,00

Coordinators

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Lecturers

Prerequisites

The student should have basic knowledge in the field of polymer chemistry and plastics. The student should also have the ability to perform simple engineering tasks related to the design of apparatus, devices and processes typical for chemical technology. In addition, student should be able to search information from specified sources.

Course objective

Providing knowledge related to the strucures, types, properties, applications and methods of obtaining composites, nanomaterials and special plastics. Acquiring the ability to design composite materials with particular attention to the choice of techniques for obtaining products with certain properties. The ability to work in a team.

Course-related learning outcomes

Knowledge:
1. Student has a well-established and expanded knowledge in the field of the structure, properties and methods of obtaining composite materials, nanomaterials and special materials [K_W11]
2. The student has expanded and in-depth knowledge in the field of polymer chemistry and material

engineering, allowing for the formulation and implementation of complex tasks related to the design of composite materials and nanomaterials [K_W2]
3. Student has expanded knowledge about the latest technologies of composite materials, nanomaterials and special plastics with particular emphasis on current development trends and principles of Closed Circulation Economy [K_W06]

Skills:
1. The student has the ability to professionally present the effects of design in the form of presentations [K_U6]
2. Student is able to design a technological process for the production of composite materials and nanomaterials with assumed properties and applications [K_U23]
3. The student is able to verify the concepts of engineering solutions for the design of composite materials and nanomaterials in relation to the current state of knowledge in chemical technology and material engineering [K_U10]

Social competences:
1. Student is able to cooperate in a team and is aware of the responsibility for own work and shared responsibility for the effects of team work [K_K4]
2. The student is able to think and act in a creative way and actively engage in solving the problems during designing composite materials [K_K6]
3. The student is aware of the limitations of their own knowledge and understanding of the need for further education in the field of designing new composite materials, nanomaterials and special materials [K_K1]

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Lectures:
Knowledge acquired in the lectures i is verified in the form of a test after the end of the lecture cycle. The test consists of 20-30 questions (test and open). Passing threshold: 50% of points. Final issues on the basis of which questions are prepared will be sent to students by e-mail using the university e-mail system.
In the case of remote lectures - the colloquium will be held on-line using the university infrastructure.
Projects:
The skils in the project classes are verified based on the implementation of the project task. In addition, the multimedia presentation presented during the classes is evaluated, during which discussion on the project assumptions is realized.
In the case of remote classes, the presentation and discussion will take place online using the university infrastructure.

Programme content

Issues concerning the strucures, types, properties, applications and methods of obtaining composites, nanomaterials and special plastics, design composite materials with particular attention to the choice of techniques for obtaining products with certain properties.

Course topics

Lectures:
Definition of the composites. The classifications and types of composites. Composite matrices: polymers, ceramics, metals. Types of fillers. Dispersion-reinforced composites. Composites reinforced with particles. Fiber-reinforced composites. Structural composites- laminates and layered. Parameters influencing the properties of the composites. The problems related to interfacial adhesion between components of composite materials. Methods to improve of adhesion in composite systems. Biocomposites- composites based on degraded components, such as lignocellulosic fillers and starch. Recycling of composite materials and the assumptions of the circular economy. Methods of the preparation of composites: contact technique, spraying method, resin transfer moulding method (RTM), sheet mold compound method (SMC), bulk molding compound (BMC), infusion method, pultrusion method, "prepreg" method, continuous production of profiles and winding the continuous fiber, rotational molding, extrusion, injection molding, pressing. The application of composites in many

industries, such as automotive, construction, sports, aviation, electrotechnical and medicine. Definition of the nanocomposites. Nanocomposites. Types of nanocomposites. Methods of the preparation of nanocomposites. Structure of nanocomposites- exfoliation and intercalation processes. The properties and applications of nanocomposites. Special plastic. Semiconductive and conductive materials. Conductive composites. Ionic polymers-polyelectrolytes. Photoconductive material. Plasma plastics. Heat-resistant plastic.
Projects
Tasks related to the design of technological lines to obtain composite materials and nanomaterials. The criterion for selection of the type of composite and composite components. The choice of technique for obtaining of composite materials. Selection of required equipment for the production of composite product. Basic calculations for optimization of processing parameters. Calculations related to the determination of the basic mechanical properties of composites and nanomaterials. Completing a project task.

Teaching methods

1. Lecture: multimedia presentation
2. Projects: classes using computers, materials necessary for design - prospectuses, plastics databases, modifying additives, catalog of machines and devices together with characteristics of parameters for designing technological lines

Bibliography

Basic:
1. Z. Floriańczyk, S. Penczek, Chemia Polimerów, t.III, Polimery naturalne i polimery o specjalnych właściwościach, Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2001
2. A. Wilczyński, Polimerowe kompozyty włókniste. Własności, struktura, projektowanie, WNT, Warszawa 1996
3. W. Królikowski, Tworzywa wzmocnione i włókna wzmacniające, WNT, Warszawa 1988.
4. B. Jurkowska, B. Jurkowski, Sporządzanie kompozycji polimerowych, elementy teorii i prak-tyki, WNT, Warszawa 1995
5. J. Nowacki, Materiały kompozytowe, Wydawnictwo Politechniki Łódzkiej, Łódz 1993
6. K. Kurzydłowski, M. Lewandowska, Nanomateriały inżynierskie konstrukcyjne i funkcjonalne, PWN, Warszawa 2010

Additional:
1. S. K. Mazumdar, Composites manufacturing- materials, product, and process engineering, CRS Press, New York 2002
2. S. Kalia, B.S. Kaith, I. Kaur, Cellulose fibers: bio- and nano-polymer composites, Springer, New York 2011
3. Materiały kompozytowe- właściwości, wytwarzanie, zastosowanie, Prace Naukowe Instytutu Budownictwa Politechniki Wrocławskiej, vol. 80, nr 29, 2001

Breakdown of average student's workload

	Hours	ECTS
Total workload	50	2,00
Classes requiring direct contact with the teacher	30	1,00
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	20	1,00