STUDY MODULE DESCRIPTION FORM

Name of the module/subject	Code
Composites, nanomaterials and special materials	**1010702211010722973**

Field of study	Profile of study (general academic, practical)	Year /Semester
Chemical Technology	**(brak)**	**1 / 1**
Elective path/specialty	Subject offered in:	Course (compulsory, elective)
Polymer Technology	**Polish**	**obligatory**

Cycle of study:	Form of study (full-time,part-time)
Second-cycle studies	**full-time**

No. of hours	No. of credits
Lecture: **1** Classes: **-** Laboratory: **-** Project/seminars: **1**	**1**

Status of the course in the study program (Basic, major, other)	(university-wide, from another field)
(brak)	**(brak)**

Education areas and fields of science and art	ECTS distribution (number and %)

Responsible for subject / lecturer:

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Prerequisites in terms of knowledge, skills and social competencies:

1	**Knowledge**	Basic knowledge of polymer chemistry and plastics useful for formulating and solving simple problems in the field of study.
2	**Skills**	The ability to acquire information from literature, database, other carefully selected sources. Ability to implement of simple engineering tasks related to the design of equipment and chemical technology processes.
3	**Social competencies**	Understanding the need for further education and improve their professional competences.

Assumptions and objectives of the course:

1. Knowledge related to structure, types, properties, applications and method of preparation of composites, nanocomposites and special plastics.
2. Design fundamentals of composite materials with a special focus on choice of preparation technique.
3. Development among students the teamwork skills.

Study outcomes and reference to the educational results for a field of study

Knowledge:

1. The student has a well-established and expanded knowledge in the field the structure, properties and preparation methods of composites, nanocomposites and special polymers. - [K_W11]
2. The student has a well-established and expanded knowledge in the field the chemistry and materials science allowing for the formulation and implementation of complex tasks related to the design of composite materials and nanomaterials. - [K_W02]
3. The student has expanded knowledge in the field the latest technology of composites, nanocomposites, and special plastics with a special focus recent developments. - [K_W06]

Skills:

1. 1. The student has the ability to professional presentation of the effects of design in the form of presentation. - [K_U06]
2. The student can design a technological process on the production of any composite materials and nanomaterials. - [K_U23]
3. The student can verify concepts of engineering solutions on designing composite materials and nanomaterials with regard to the current state of knowledge in the field the chemical technology and materials engineering. - [K_U10]

Social competencies:

1. Students can work in a team and have aware of their responsibility for your work and responsibility for the results of the team's work. - [K_K04]
2. The student is able to think and act in a creative way and actively engage in solving the problems posed. - [K_K06]

Assessment methods of study outcomes

1. Rating of completion test (K_W11, K_W06)
2. Rating of activity during project classes (K_U10, K_K06)
3. Rating of the executed project (K_W02, K_U23, K_K04)
4. Rating of presentation of design task (K_U06)

Course description

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. The problems related to interfacial adhesion between components of composite materials. Methods to improve of adhesion. Biocomposites- composites based on degraded components, such as lignocellulosic fillers and starch. Factors influencing the properties of the composites. 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. 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 plastics. Conductive composites. Ionic polymers-polyelectrolytes. Photoconductive material. Plasma plastics. Heat-resistant plastic.

Calculations related to the determination of the basic mechanical properties of composites and nanomaterials. 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 obtaining of composite materials. Selection of required equipment for the production of composite product. Basic calculations for optimization of processing parameters.

Basic bibliography:

1. Z. Floriańczyk, S. Penczek, Chemia Polimerów, t.III, Polimery naturalne i polimery o specjal-nych 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 bibliography:

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

Result of average student's workload

Activity	Time (working hours)
1. participation in lectures	15
2. participation in design classes	15
3. project preparation and the presentation	10
4. preparation to the completion test	7
5. participation in the consultation associated with the learning process, especially design classes	5

Student's workload

Source of workload	hours	ECTS
Total workload	52	1
Contact hours	20	1
Practical activities	25	1