COURSE DESCRIPTION CARD - SYLLABUS

Course name
Hybrid materials and fillers [S2TCh2E-KiN>MHiN]

Course

Field of study
Chemical Technology

Year/Semester
1/2

Area of study (specialization)
Composites and Nanomaterials

Profile of study
general academic

Level of study
second-cycle

Course offered in
english

Form of study
full-time

Requirements
compulsory

Number of hours

Lecture
15

Laboratory classes
30

Other (e.g. online)
0

Tutorials
0

Projects/seminars
0

Number of credit points

4,00

Coordinators

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Lecturers

Prerequisites

Structured and systematic knowledge in the field of general and inorganic chemistry, organic chemistry and chemical technology as well as polymers, nanomaterials and composites, and apparatus of the chemical industry (the curriculum of the full-time first cycle studies). Ability to solve elementary engineering problems based on knowledge. Ability to obtain information from the indicated sources in a foreign language. Understanding the need for further education, understanding the need to expand their competences, readiness to cooperate within a team.

Course objective

Obtaining theoretical and practical knowledge in the field of technology of nanomaterials, hybrid materials and fillers. Ability to select chemical raw materials and semi-finished products used in different area of technology including polymer processing, evironmental protection and modern materials science. Understanding the basic industrial processes and unit operations related to the technology of obtaining and modifying of inorganic polymer fillers. Understanding the methods of obtaining inorganic and inorganic-organic products, including hybrid products with defined structural and morphological properties. Additionally information related to biopolymers, scaffolds, and platforms for sensors will be given.

Course-related learning outcomes

Knowledge:
K_W2 - has expanded and in-depth knowledge in chemistry and other related areas of science, allowing to formulate and solve complex tasks related to chemical technology
K_W3 - has knowledge of complex chemical processes, including the appropriate selection of materials, raw materials, methods, techniques, apparatus and equipment for carrying out chemical processes and characterizing the products obtained
K_W6 - has expanded knowledge of the latest chemical and material technologies, including advanced materials and nanomaterials technologies, knows current trends in the development of chemical industrial processes
K_W7 - knows modern methods of testing the structure and properties of materials, necessary to characterize raw materials and products of the chemical and related industries
K_W11 - has a well-established and expanded knowledge of the selected specialty
K_W13 - has extended knowledge of advanced devices and apparatus used in chemical technology
K_W14 - has knowledge of selected issues of modern chemical knowledge and aspects of copyright and industrial property

Skills:
K_U1 - has the ability to obtain and critically evaluate information from literature, databases and other sources, and formulate opinions and reports on this basis
K_U2 - has the ability to work in a team and lead a team
K_U5 - can independently determine the directions of further education and implement self-education
K_U11 - is able to properly verify the concepts of engineering solutions in relation to the state of knowledge in technology and chemical engineering
K_U12 - has the ability to adapt knowledge of chemistry and related fields to solve problems in the field of chemical technology and planning new industrial processes
K_U15 - can critically analyze industrial chemical processes and introduce modifications and improvements in this area, using the acquired knowledge, including knowledge about the latest achievements of science and technology
K_U16 - has the ability to assess the technological suitability of raw materials and the selection of the technological process in relation to the quality requirements of the product
K_U23 - has the ability to use the knowledge acquired under the specialty in professional activity

Social competences:
K_K1 - is aware of the need for lifelong learning and professional development
K_K2 - is aware of the limitations of science and technology related to chemical technology, including environmental protection
K_K4 - observes all rules of teamwork; is aware of the responsibility for joint ventures and achievements in professional work
K_K6 - can think and act in a creative and entrepreneurial way

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Lecture - Stationary form - The knowledge gained throughout the lecture is evaluated via written/oral exam graded on the basis of a precent system: 3 - 50.1%-60.0%; 3.5 - 60.1%-70%; 4 - 70.1%-80.0%; 4.5 - 80.1%-90%; 5 - from 90.1%.Lecture - Online form - The knowledge gained throughout the lecture is evaluated via the eKursy platform in the form of a written exam. The exam consists of 3-5 open questions that students answer in "live view" mode with the webcam turned on via the eMeeting or Zoom platforms, or/and closed test 10-20 questions (multiple choice) that students answer using the eKursy platform's test module.Grade criteria: 3 - 50.1%-60.0%; 3.5 - 60.1%-70%; 4 - 70.1%-80.0%; 4.5 - 80.1%-90%; 5 - from 90.1%.
Laboratory - Stationary form - Oral response or written test (3-5 questions) based on the material in the exercises and the specified theoretical issues; presence and completion of all laboratory exercises in the study program; grade based on reports produced after each exercise. The average grades of the oral/written responses and reports for each exercise will be divided by the number of exercises completed to give a final grade. Grade criteria: 3 - 50.1%-60.0%; 3.5 - 60.1%-70%; 4 - 70.1%-80.0%; 4.5 - 80.1%-90%; 5 - from 90.1%.
Laboratory - Online form - Oral response and/or written test (10-20 closed, multiple choice test questions) based on the material contained in the exercises, tutorial videos, and theoretical issues provided, conducted in "live view" mode with the webcam turned on via eMeeting or Zoom platform

during a direct conversation with the teacher and/or using the test module on the eKursy platform; online presence and completion of the eKursy platform. The average grade of the oral/written responses and reports for each exercise, divided by the number of exercises completed, will be used to determine the final grade. Grade criteria: 3 - 50.1%-60.0%; 3.5 - 60.1%-70%; 4 - 70.1%-80.0%; 4.5 - 80.1%-90%; 5 - from 90.1%.

Programme content

Nanotechnology
Nanomaterials - types and characteristics
Fillers - definitions and general characteristics
Hybrid materials - examples, characteristics and application
Composite materials - examples, characteristics and application
Natural and synthetic fillers
Pigments and dyes
Hybrid micro- and nanoplatforms for sensors and biosensors
Biopolymers
Techniques used to characterize nanomaterials and composites
Application of hybrid materials for nanomedicine

Teaching methods

Lecture - multimedia presentation, materials in the form of pdf files on the eKursy platform.
Laboratory - teaching materials for the laboratory in pdf files, practical exercises, tutorial videos on the eKursy platform.

Bibliography

Basic:
1. G. Wypych, Handbook of fillers, 3rd ed., ChemTec Publishing, Toronto 2010.
2. M. Xantos, Functional fillers for plastics, Wiley-VCH, New York 2010.
3. E.F. Vansant, P. van der Voort and K.C. Vrancken, Characterization and chemical modification of the silica surface, Elsevier, Amsterdam 1995.
4. J.A. Rodriguez, M. Fernandez-Garcia, Synthesis, properties and applications of oxide nanomaterials, John Wiley & Sons, New Jersey 2007.
5. Ch. Kumar, Nanostructured oxides, Wiley-VCH, Weinheim 2009.
6. A. Szymański, Biomineralizacja i Biomateriały, Wydawnictwo Naukowe PWN, 1991.
7. P. Gomez-Romero, C. Sanchez, Functional Hybrid Materials, Wiley, 2003.
8. W. Nawrocki, Sensory i systemy pomiarowe, Politechnika Poznańska, 2011.

Additional:
1. Scientific articles related to the content of the lecturers.
2. V.K. Thakur, M.K. Thakur, Functional Biopolymers, Springer, 2018.
3. A.W. Adamson, A.P., Gast, Physical chemistry of surface, John Wiley & Sons, Toronto 1997.
4. A.S. Bassi, G. Knopf, Smart biosensor technology, CRC Press, 2020.
5. Laboratory materials.

Breakdown of average student's workload

	Hours	ECTS
Total workload	100	4,00
Classes requiring direct contact with the teacher	50	2,00
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	50	2,00