COURSE DESCRIPTION CARD - SYLLABUS

Course name
Technology of monomers, fillers and additives [S2TCh2-TP>TM,NiŚP]

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
30

Laboratory classes
30

Other (e.g. online)
0

Tutorials
0

Projects/seminars
0

Number of credit points

3,00

Coordinators

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Prerequisites

Structured and systematic knowledge in the field of general and inorganic chemistry, organic chemistry and chemical technology, 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 Polish and 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 monomers, fillers and additives. Understanding the basic sources and industrial processes for producing monomers in the petrochemical industry. Ability to select chemical raw materials and semi-finished products used in polymer technology. 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.

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 acquired during the lecture is verified in the form of a written exam after the completed cycle of lectures. The exam consists of 5-10 open questions and/or 10-20 open or closed test questions (multiple choice).
Online form - the knowledge acquired during the lecture is verified in the form of a written exam after the completed cycle of lectures via the eKursy platform. The exam includes 5 open questions that students answer in the "live view" mode with the webcam turned on via eMeeting or Zoom platform, and 20-30 closed test questions (multiple choice), to which students answer using the test module on

the eKursy platform. 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 answer or written test (3-5 questions) from the material contained in the exercises and the given theoretical issues; presence and realization of all laboratory exercises provided in the study program; grade from reports prepared after each exercise. A final grade will be given based on the average grades of the oral/written answers and reports for each exercise, divided by the number of exercises performed.
Online form - oral answer and/or written test (10-20 closed, multiple choice test questions) from the material contained in the exercises, tutorial videos and the theoretical issues provided, conducted in the "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 all laboratory exercises provided in the study program; grade from the reports prepared after each exercise and sent via the eKursy platform or by e-mail using the university's e-mail system. A final grade will be given based on the average grade of the oral/written answers and reports for each exercise, divided by the number of exercises performed. 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

The lecures consist of two parts:
1. The first part of lectures (Monomer Technology) cover the following topics:
1.1. Raw materials for the petrochemical industry. Trends in petrochemical technology.
1.2. Thermal processes in the refinery and petrochemical industry. Olefin pyrolysis as a source of ethylene, propylene, C4 fraction and pyrolysis gasoline.
1.3. The catalytic processes in the refinery and petrochemical industry. Gasoline reforming as a source of benzene, toluene and xylenes.
1.4. Hydrogen sources. The hydrogenation and dehydrogenation process in the refinery industry.
1.4.1. Industrial production of cyclohexane.
1.4.2. Industrial production of styrene.
1.5. The role of dehydration processes for the technology obtaining monomers: ethylene, styrene, gasoline and olefins (Cenpes, Halcon, MTO, MTG).
1.6. Modern technologies for production of vinyl chloride and terephthalic acid.
2. The second part of lectures - The technology of fillers and additives.
2.1. Monomers, fillers and additives - definitions, classification and their use.
2.2. Silicon fillers - division, methods of preparation, change of hydrophilic-hydrophobic properties and their application.
2.3. Surface modification of inorganic systems.
2.4. Organic and inorganic pigments, with a particular focus on titanium dioxide production.
2.5. Types and mechanisms of action of flame retardant materials and aspects of their use.

Teaching methods

Lecture: multimedia presentation.
Laboratory - teaching materials for the laboratory in pdf files, practical exercises.

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. A.W. Adamson, A.P., Gast, Physical chemistry of surface, John Wiley & Sons, Toronto 1997.
6. Ch. Kumar, Nanostructured oxides, Wiley-VCH, Weinheim 2009.
7. E. Grzywa, J.Molenda Technologia podstawowych syntez organicznych: Surowce do syntez Tom I, WNT, Warszawa 2015.
8. E. Grzywa, J.Molenda Technologia podstawowych syntez organicznych: Surowce do syntez Tom II, WNT, Warszawa 2015.

Additional:
1. J. Szarawara, J. Piotrowski, Podstawy teoretyczne technologii chemicznej, WNT, Warszawa 2010.
2. G. Ertl, H. Knözinger, F. Schüth, J. Weitkamp, Handbook of heterogeneous catalysis, WILEY-VCH, Weinheim 2008.
3. K. Alejski, I. Miesiąc, K. Prochaska, M. Regel-Rosocka, A. Sobczyńska, J. Staniewski, K. Staszak, M. Staszak, M. Wiśniewski, Podstawy technologii chemicznej i inżynieria reaktorów. Część I i II. Pod redakcją M. Wiśniewskiego i K. Alejskiego, Wyd. Politechniki Poznańskiej, Poznań 2017.
4. Materiały laboratoryjne (opracowania ćwiczeń).

Breakdown of average student's workload

	Hours	ECTS
Total workload	75	3,00
Classes requiring direct contact with the teacher	60	2,50
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	15	0,50