COURSE DESCRIPTION CARD - SYLLABUS

Course name

Physicochemical methods in the identification of chemical compounds

Course

Field of study

Circular System Technologies

Area of study (specialization)

Level of study

First-cycle studies

Form of study

full-time

Year/Semester

3/5

Profile of study

general academic

Course offered in

Polish

Requirements

compulsory

Number of hours

Lecture

30

Laboratory classes

30

Other (e.g. online)

Tutorials

Projects/seminars

Number of credit points

4

Lecturers

Responsible for the course/lecturer:

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Wydział Technologii Chemicznej

ul. Berdychowo 4, 60-965 Poznań

Responsible for the course/lecturer:

Prerequisites

Knowledge in the field of physical chemistry, organic chemistry, basics of analytical chemistry, basics of chemical apparatus, mathematics, the ability to solve elementary problems in general and instrumental chemistry based on the acquired knowledge, the ability to obtain information from indicated sources in Polish and a foreign language, understand the need for training, understanding the need to expand one's competences, willingness to cooperate within the team

Course objective

Provide students with basic knowledge of techniques and methods of analysis as well as the characteristics of various chemical compounds with different physical states and purity. Acquainting students with UV, IR, NMR and MS spectroscopic methods, methods of studying the surface of solids (IGC, ATR-FTIR, XPS, ToF-SIMS, ICP), imaging methods (SEM, TEM, AFM), methods of thermal analysis (TG, DSC), particle size tests. During the laboratory classes, students will learn how to properly prepare samples for testing with various techniques and perform measurements using various instrumental techniques (UV, IR, IGC). They will interpret the spectra and the results of the imaging methods. Familiarizing students with good practices when conducting physicochemical analyzes.

Course-related learning outcomes

Knowledge

K_W11, P6S_WG - has knowledge of techniques, methods of identification and characterization of main and by-products in circular system technologies

Skills

K_U01, P6S_UW - can obtain information from literature, databases and other sources related to circular system technologies, also in a foreign language, integrate them, interpret them, draw conclusions and formulate opinions

K_U03, P6S_UW - plans, selects equipment and scientific apparatus, performs research and analyzes the results and draws conclusions

K_U04, P6S_UU - has the ability to self-educate, is able to use source information in Polish and a foreign language in accordance with the principles of ethics, reads with understanding, conducts analyzes, syntheses, summaries, critical assessments and correct conclusions

K_U05, P6S_UW, P6S_UK - correctly uses in the discussion and properly uses nomenclature and terminology in the field of circular economy, chemistry, technology and chemical engineering, environmental protection and related disciplines, also in a foreign language

K_U08, PS6_UO - can plan and organize work individually and in a team

K_U09, PS6_UO - can interact with other people as part of work on circular system technology and of an interdisciplinary nature

K_U10, P6S_UW - selects methods of process control and quality assessment of raw materials, products and waste

K_U13, P6S_UW - selects analytical methods suitable for the qualitative and quantitative determination of chemical compounds

K_U15, P6S_UW - based on the acquired knowledge, can develop an independent or team project/report on the work performed and make its multimedia presentation

Social competences

K_K01, P6S_KR - behaves professionally in every situation, takes responsibility for decisions made in connection with professional duties, acts in accordance with moral principles and the principles of professional ethics

K_K02, P6S_KR - shows independence and inventiveness in individual work, and effectively works in a team, playing various roles in it; objectively assesses the effects of his own work and that of team members

K_K04, P6S_KR, P6S_KK - cares about the safety of his own and others' work, applies appropriate procedures and rules in emergencies

K_K05, P6S_KK - objectively assesses the level of his knowledge and skills, understands the importance of improving professional and personal competences adequately to changing social conditions and the progress of science

K_K07, P6S_KK - shows care and full responsibility for the specialist equipment entrusted to him for testing

K_K08, P6S_KK, P6S_KO, P6S_KR - participates in discussions and is able to conduct discussions, is open to different opinions and ready to assertively express feelings and critical comments

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Lecture: evaluation work

Laboratories: oral and written test before each class, exercise reports

Programme content

1. Spectroscopic techniques (IR, Raman, UV-VIS, NMR, MS).

2. Techniques for examining the surface of solids (XPS, IGC, ToF SIMS, ICP).

3. Imaging techniques (SEM, TEM, AFM).

Teaching methods

Lecture, discussion, practical exercises

Bibliography

Basic

1. Robert M. Siverstein, Francis X. Webster, David J. Kiemle "Spectroscopic methods for the identification of organic compounds", Polish Scientific Publishers PWN 2007, in Polish or in English.

2. Z. Sarbak, "Instrumental methods in the research of adsorbents and catalysts", Scientific Publishers Adam Mickiewicz University, Poznań 2005, in Polish.

3. A. Voelkel, K. Bielicka-Daszkiewicz, K. Milczewska (Ed.) "Applications of chromatographic techniques", PP Publishing House, Poznań 2005, in Polish.

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6. H. Barańska, A. Łabudzińska, J. Terpiński, "Laser Raman spectrometry, analytical applications", 1981, PWN, Warsaw, in Polish.

7. Smith E., Dent G., Modern Raman Spectroscopy - A Practical Approach, John Wiley &Sons, Ltd, Chichester 2005.

8. R.W. Kelsall, I.W. Hamley, M. Geoghegan: Nanotechnologie, Warszawa: Wydawnictwo Naukowe PWN, 2008. ISBN 978-83-01-15537-7.

9. Klein, Tobias; Buhr, Egbert; Frase, Carl G. (2012). TSEM: A Review of Scanning Electron Microscopy in Transmission Mode and Its Applications. Advances in Imaging and Electron Physics. 171. pp. 297–356. doi:10.1016/B978-0-12-394297-5.00006-4. ISBN 9780123942975.

10. W. Zielenkiewicz: Measurements of thermal effects: methods and applications. Warsaw: PAN CUN, 2000, in Polish.

11. W. Szczepaniak: Instrumental methods in chemical analysis. Ed. 5. Warsaw: Scientific Publisher PWN, 2008, pp. 373-375, in Polish.

Additional

1. L.A. Kazicyna, N.B. Kupletska, "Spectroscopic methods for determining the structure of organic compounds", PWN, Warsaw, 1989, in Polish.

2.W. Zieliński, collective work, "Spectroscopic methods and their application to the identification of organic compounds", WNT, Warsaw, 1995, in Polish.

3. A. Płaziak, "Mass spectroscopy of organic compounds" Poznań, Wyd. AMU, 1997, in Polish.

4. The essence of chromatography, C.F. Poole, Elsevier, Amsterdam, 2003

5. A.Voelkel, B. Strzemiecka, K. Adamska, K. Milczewska, Inverse gas chromatography as a source of physicochemical data, J. Chromatogr. A, 1216 (2009) 1551-1566.

6. B. Strzemiecka, A. Voelkel, J. Donate-Robles,J.M. Martín-Martínez, Assessment of the surface chemistry of carbon blacks by TGA-MS, XPS and inverse gas chromatography using statistical chemometric analysis, Applied Surface Science, 316 (2014) 315-323.

7. B. Strzemiecka, A. Voelkel, J. Zięba-Palus, T. Lachowicz, Assessment of the chemical changes during storage ofphenol-formaldehyde resins pyrolysis gas chromatography mass spectrometry, inverse gas chromatography and Fourier transform infra red methods, 1359 (2014) 255-261.

8. A. Voelkel, H. Grajek, B. Strzemiecka, K. Adamska, New Essential Events in Modern Applications of Inverse Gas Chromatography, Analytical Separation Science, First Edition by J.L. Anderson, A. Berthod, V.P. Esteves, A.M. Stalcup, Wiley VCH Verlag GmbH & Co., KGaA, 2015, chapter 8, pp. 979-997.

9. "Introduction to Electron Microscopy" (PDF). FEI Company. p. 15. Retrieved 12 December 2012.

10. internet site: https://science.howstuffworks.com/scanning-electron-microscope2.htm

Breakdown of average student's workload

	Hours	ECTS
Total workload	100	4,0
Classes requiring direct contact with the teacher	65	2,5
Student's own work (literature studies, preparation for laboratory, preparation for evaluation work) [1]	35	1,5

[1] delete or add other activities as appropriate