COURSE DESCRIPTION CARD - SYLLABUS

Course name
Green materials [S2TOZ1-TSO>ZM]

Course

Field of study
Circular System Technologies

Year/Semester
1/1

Area of study (specialization)
Renewable raw material technologies

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
15

Other
0

Tutorials
0

Projects/seminars
0

Number of credit points

3,00

Coordinators

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Lecturers

Prerequisites

The student possesses organized, theoretically grounded knowledge of key issues related to technologies used in the circular economy. They can effectively gather information from literature, databases, and other sources, including in English, as well as analyze, interpret, draw conclusions, and formulate justified opinions. The student is capable of collaborating in a team and prioritizing tasks necessary for the achievement of set objectives.

Course objective

Gaining knowledge about green materials used in the circular economy, produced in accordance with the principles of sustainable development, using modern and cost-effective methods that minimize negative impacts on the natural environment.

Course-related learning outcomes

Knowledge:
1. The student possesses advanced, structured, and theoretically grounded knowledge about green materials and their role in sustainable development and the circular economy. The student also understands the reasons for implementing these materials in various industrial sectors. [K_W02]

2. The student possesses advanced, detailed knowledge of sustainable production and the use of green materials, as well as an understanding of developmental trends and innovations supporting the circular economy. [K_W03]
3. The student has a solid knowledge of environmentally friendly modern industrial technologies. [K_W05]

Skills:
1. The student is able to effectively communicate verbally with specialists in green materials, sustainable development, and the circular economy, as well as with experts from related fields. [K_U01]
2. The student has the ability to selectively utilize knowledge from chemistry and related fields in planning and conducting research tasks related to green materials, and is capable of analyzing their environmental impact in the context of the circular economy. [K_U08]
3. The student can work independently, plan and execute their own lifelong learning, and collaborate effectively in a team. [K_U05, K_U09]

Social competences:
1. The student understands the need to promote knowledge about green materials and sustainable technological solutions that support the circular economy. [K_K01]
2. The student critically evaluates their knowledge in the field of research on green materials and recognizes the need for continuous education and the enhancement of their professional, personal, and social competencies in the area of modern sustainable technologies. [K_K03]

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Lecture - written exam; evaluation criteria:
Satisfactory: 50.1% - 60.0%
Satisfactory Plus: 60.1% - 70.0%
Good: 70.1% - 80.0%
Good Plus: 80.1% - 90.0%
Very Good: 90.1% and above.
Laboratory: ongoing assessment during laboratory classes, oral/written responses, reports from laboratory exercises, evaluation of teamwork; assessment criteria:
Satisfactory (3) - basic theoretical and practical preparation, ability to prepare reports on completed laboratory exercises at a basic level;
Good (4) - practical preparation supported by theoretical knowledge, ability to formulate appropriate conclusions, active participation in classes with a desire to acquire additional knowledge;
Very Good (5) - very good preparation for classes, ability to formulate conclusions at an advanced level, precise execution of assigned tasks, independent search for additional theoretical knowledge, coordination of work in a research team.

Programme content

The program content includes the characterization of green materials, focusing on their unique properties and applications in various industries.

Course topics

Lecture:
1. Introduction to green materials: definition and significance of green materials in the context of sustainable development and the circular economy.
2. Types of green materials: classification and examples (biomaterials, biodegradable materials, materials of natural origin).
3. Green chemicals in chemical synthesis, biodegradable and natural solvents, catalysts for green chemistry.
4. Surfactants of natural origin, biosurfactants, biodegradable surfactants.
5. Green polymeric materials.
6. Biopesticides and natural pesticides.
7. Eco-friendly dyes and pigments.
8. Biodegradable lubricants and oils.

9. Examples of applications in various industries (building construction, automotive, packaging, pharmaceutical industry, cosmetic industry, agriculture).
10. The future of green materials: challenges and opportunities for development in the context of global ecological trends.
Laboratory:
Laboratory problems: students will use the knowledge gained in the lectures to acquire practical skills related to laboratory techniques used in the synthesis, modification and study of the properties of selected green materials.

Teaching methods

Lecture - multimedia presentation.
Laboratory:
Laboratory topics: Students will utilize the knowledge gained in lectures to acquire practical skills related to the laboratory techniques used in the synthesis, modification, and study of the properties of selected green materials.

Bibliography

Basic:
1. Burczyk B.: Zielona chemia: zarys, Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2014.
2. Khalaf M.N.: Green polymers and environmental pollution control, Apple Academic Press Inc., Oakville, Waretown 2016.
3. Török B., Dransfield T.: Green chemistry: an inclusive approach, Elsevier, Amsterdam 2018.
4. Kolb V.M.: Green organic chemistry and its interdisciplinary applications, CRC Pres Taylor & Francis Group, Boca Raton 2016.
5. Matlack A.S.: Introduction to green chemistry, New York; Basel; Marcel Dekker, 2001.
6. Nelson W.M., Green solvents for chemistry: perspectives and practice, Oxford University Press, Oxford 2003.

Additional:
1. Imae T.: Nanolayer research: methodology and technology for green chemistry, Elsevier, Amsterdam 2017.
2. Afonso C.A. M., Crespo J. G.: Green separation processes: fundamentals and applications, Wiley-VCH, Weinheim 2005.
3. Kaczmarek D. K., Pacholak A., Burlaga N., Wojcieszak M., Materna K., Kruszka D., Dąbrowski P., Sobańska K., Kaczorek E. (2023). Dicationic Ionic Liquids with an Indole-3-butyrate Anion-Plant Growth Stimulation and Ecotoxicological Evaluations. ACS Sustainable Chemistry & Engineering, 11(36), 13282-13297.

Breakdown of average student's workload

	Hours	ECTS
Total workload	75	3,00
Classes requiring direct contact with the teacher	49	2,00
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	26	1,00