GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Sustainable technologies and ecological footprint: low - emission solutions in practice, PG_00072671						
Field of study	Chemical Technology, Chemistry, Biotechnology, Engineering and Technologies of Energy Carriers, Corrosion , Green Technologies, InfoBioChem						
Date of commencement of studies	February 2026		Academic year of realisation of subject	2026/2027			
Education level	second-cycle studies		Subject group				
Mode of study	Full-time studies		Mode of delivery	at the university			
Year of study	1		Language of instruction	English			
Semester of study	2		ECTS credits	3.0			
Learning profile	general academic profile		Assessment form	assessment			
Conducting unit	Department of Process Engineering and Chemical Technology -> Faculty of Chemistry -> Faculties of Gdańsk University of Technology						
Name and surname of lecturer (lecturers)	Subject supervisor		dr inż. Aleksandra Małachowska				
	Teachers						
Lesson types	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	15.0	0.0	0.0	15.0	15.0	45
	E-learning hours included: 0.0						
Learning activity and number of study hours	Learning activity	Participation in didactic classes included in study plan		Participation in consultation hours	Self-study	SUM	
	Number of study hours	45		5.0	25.0	75	
Subject objectives	The aim of the course is to familiarize students with methods for assessing the environmental impact of technologies, products, and processes using ecological footprint concepts and Life Cycle Assessment (LCA) methodology. The course develops skills in designing and evaluating low-emission technological solutions in accordance with the principles of sustainable development, circular economy, and responsible engineering. It also enhances students' abilities to critically analyse environmental data and effectively communicate the benefits of environmentally friendly technologies to various stakeholder groups.						

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K7_U01] designs experiments using computer methods of data analysis, computer simulations and based on the state of the knowledge in accordance with the latest scientific literature	Is able to design and conduct analyses of the environmental impact of technologies, products, and processes using IT tools, databases, and environmental assessment methods, as well as interpret the results and draw conclusions based on the current state of knowledge and the latest scientific findings	[SU3] Assessment of ability to use knowledge gained from the subject [SU4] Assessment of ability to use methods and tools [SU2] Assessment of ability to analyse information
[K7_W01] defines the phenomena, processes and laws of nature used to produce consumer goods and provide services	Has knowledge of the natural phenomena, processes, and laws that determine the functioning of technologies, products, and services, and understands their impact on the environment and their significance for the implementation of sustainable development principles.	[SW1] Assessment of factual knowledge
[K7_W03] selects methods of data analysis, including statistical and modelling, useful for solving scientific and technological problems	Is aware of the methods of data analysis and interpretation used in assessing the environmental impact of technology and understands the principles for selecting these methods to address specific research and application problems.	[SW1] Assessment of factual knowledge [SW3] Assessment of knowledge contained in written work and projects
[K7_W04] recognises scientific, technological, organisational and economic opportunities and constraints in technology and related fields	Understands the scientific, technological, organizational, and economic factors, opportunities, and limitations that shape the implementation of low-carbon technologies and solutions aimed at reducing the environmental footprint.	[SW1] Assessment of factual knowledge [SW2] Assessment of knowledge contained in presentation [SW3] Assessment of knowledge contained in written work and projects
[K7_W06] integrates knowledge from different disciplines, principles of intellectual property protection and patent law, relevant for appropriate interpretation and application in scientific, sustainable economic activities	Has knowledge of technical, environmental, and socio-economic sciences and understands their interrelationships in the context of evaluating and designing solutions that mitigate the impact of human activities on the environment, taking into account the principles of sustainable development, intellectual property protection, and the responsible implementation of innovations.	[SW2] Assessment of knowledge contained in presentation [SW3] Assessment of knowledge contained in written work and projects

Subject contents

Course content – lecture

- Introduction to the concept of ecological footprint: carbon footprint, water footprint, and material footprint.
- Fundamentals of Life Cycle Assessment (LCA): methodology, databases, tools, and interpretation of results.
- Sustainable development and the transition to a low-emission economy.
- Low-emission technologies and eco-design principles.
- Circular Economy concepts and resource efficiency.
- Environmental impact assessment of technologies, products, and services.
- Social and economic aspects of implementing environmentally responsible solutions.
- Environmental communication, greenwashing, and corporate responsibility.

Course content – project

- Selection of a product, process, or service for environmental assessment.
- Identification of life cycle stages and key sources of environmental impact.
- Collection and analysis of environmental data.
- Preparation of a simplified environmental footprint assessment or Life Cycle Assessment (LCA).
- Identification of opportunities for environmental optimization.
- Development of a low-impact or low-emission improvement strategy.
- Evaluation of the environmental benefits of the proposed solution and preparation of a project report.
- Presentation and discussion of project results.

Course content – seminar

Analysis and discussion of case studies related to low-emission technologies.
Assessment of environmental impacts associated with selected industrial products and processes.
Discussion of current trends in sustainable development, climate policy, and environmental management.
Critical review of scientific literature on environmental footprints and Life Cycle Assessment (LCA).
Student presentations on selected sustainable technologies and environmental solutions.
Analysis of examples of greenwashing and environmental communication practices.
Debate on challenges and opportunities related to the implementation of low-emission technologies.
Summary and presentation of team project outcomes.

Prerequisites and co-requisites

Basic knowledge of natural sciences, environmental protection, technology, and process engineering. Ability to analyse and interpret data and use basic computer tools. Familiarity with fundamental concepts of sustainable development and environmental impacts of human activities.

<table>
<tr><td>Assessment methods and criteria</td><td colspan="2"><table>
<tr><th>Subject passing criteria</th><th>Passing threshold</th><th>Percentage of the final grade</th></tr>
<tr><td>Seminar- Practical in-class tasks</td><td>60.0%</td><td>30.0%</td></tr>
<tr><td>Lecture - Final test</td><td>60.0%</td><td>40.0%</td></tr>
<tr><td>Project - final project</td><td>60.0%</td><td>30.0%</td></tr>
</table></td></tr>
<tr><td rowspan="3">Recommended reading</td><td>Basic literature</td><td>1. Piotr Skubała – Ecological Footprint as a Tool for Lifestyle Change, 2023; application of ecological footprint analysis in environmental education and consumer habit transformation.
2. Mathis Wackernagel – Ecological Footprint: Managing Our Biological Budget, 2019; comprehensive introduction to ecological footprint methodology by the creator of the concept.
3. Małgorzata Burchard-Dziubińska, Zofia Stępniewska, Marcin Tarnawski – Low-Emission Economy, 2017.
4. Agnieszka Rzeńca – EcoCity#Environment. Sustainable, Smart and Participatory Urban Development, 2024.
5. Wackernagel M., Rees W., Our Ecological Footprint: Reducing Human Impact on the Earth, New Society Publishers, 2019
6. Hauschild M.Z., Rosenbaum R.K., Olsen S.I. (eds.), Life Cycle Assessment: Theory and Practice, Springer, 2018.
7. Guinée J.B. (ed.), Handbook on Life Cycle Assessment: Operational Guide to the ISO Standards, Springer.
8. European Commission, Life Cycle Thinking and Assessment for Sustainable Production and Consumption, Publications Office of the European Union.</td></tr>
<tr><td>Supplementary literature</td><td>• Skrzypek J., Transformacja polskiej gospodarki w kierunku niskoemisyjnym w świetle wyników wielosektorowego modelu energetycznego, PWN, 2024.
• Rzeńca A., EcoCity#Environment. Sustainable, Smart and Participatory Urban Development, Wydawnictwo Uniwersytetu Łódzkiego, 2024.
• Ellen MacArthur Foundation, Towards the Circular Economy.
• UNEP, Global Environment Outlook (GEO) – aktualne wydania.
• ISO 14040:2006 Environmental Management – Life Cycle Assessment – Principles and Framework.
• ISO 14044:2006 Environmental Management – Life Cycle Assessment – Requirements and Guidelines.
• European Environment Agency (EEA), raporty dotyczące gospodarki o obiegu zamkniętym i neutralności klimatycznej.
• Wybrane artykuły naukowe z czasopism Journal of Cleaner Production, Resources, Conservation & Recycling, Sustainable Production and Consumption oraz Environmental Science & Technology</td></tr>
<tr><td>eResources addresses</td><td></td></tr>
<tr><td>Example issues/ example questions/ tasks being completed</td><td colspan="2">Recommended Optional Course Components

Course-related activities:
Expert seminars, guest lectures, and workshops on Life Cycle Assessment (LCA), carbon footprint, water footprint, circular economy, and low-emission technologies.

Field laboratory at:
Companies implementing solutions in energy efficiency, renewable energy, waste management, recycling, or other environmental technologies.

Optional study visit to:
An industrial plant, waste recovery and recycling facility, municipal waste incineration plant, wastewater treatment plant, or another facility applying sustainable and low-emission solutions.

Conference in the field of:
Sustainable development, low-carbon transition, Life Cycle Assessment (LCA), environmental footprint assessment of products and processes, circular economy, and innovative environmental technologies.</td></tr>
<tr><td>Practical activites within the subject</td><td colspan="2">Field exercises</td></tr>
</table>

Document generated electronically. Does not require a seal or signature.