GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Water Management in Circular Systems, PG_00072445		
Field of study	Materials Engineering		
Date of commencement of studies	October 2023	Academic year of realisation of subject	2026/2027
Education level	first-cycle studies	Subject group	Obligatory subject group in the field of study
Mode of study	Full-time studies	Mode of delivery	at the university
Year of study	4	Language of instruction	Polish
Semester of study	7	ECTS credits	2.0
Learning profile	general academic profile	Assessment form	assessment
Conducting unit	Institute of Nanotechnology and Materials Engineering -> Faculty of Applied Physics and Mathematics -> Faculties of Gdańsk University of Technology		
Name and surname of lecturer (lecturers)	Subject supervisor	dr inż. Marta Prześniak-Welenc	
	Teachers	dr inż. Marta Prześniak-Welenc	

Lesson types

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	15.0	0.0	0.0	0.0	15.0	30

E-learning hours included: 0.0

eNauczanie source addresses:

Moodle ID: 5956 Gospodarka wody w obiegu zamkniętym
https://enauczanie.pg.edu.pl/2025/course/view.php?id=5956

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	30	2.0	18.0	50

Subject objectives

The aim of the course is to familiarize students with the principles of circular water management and the role of water as a key resource in modern industrial processes. Students will gain knowledge of water consumption reduction strategies, water reuse approaches, and resource and energy recovery from process water and wastewater streams. The course develops the ability to analyze and design closed-loop and cascading water systems in materials engineering processes, taking into account technological, environmental, and economic requirements. Legal, social, and environmental aspects related to the implementation of circular solutions, as well as modern monitoring and optimization technologies for water systems, are also discussed. The course provides students with the knowledge necessary to evaluate the efficiency and sustainability of industrial water management systems.

Learning outcomes	Course outcome	Subject outcome	Method of verification
	[K6_U06] Can integrate obtained information, interpret it and draw conclusions, as well as formulate and justify opinions.	The student is able to integrate and interpret information related to water consumption, treatment, and reuse in industrial processes, as well as formulate conclusions regarding the efficiency and applicability of circular water management solutions. The student can evaluate the environmental impact, resource consumption, and process efficiency of water recovery and recycling technologies, and justify the selection of proposed technological solutions.	[SU1] Assessment of task fulfilment [SU3] Assessment of ability to use knowledge gained from the subject
	[K6_U01] Can properly use selected analytical, simulation and experimental methods, as well as devices for measuring the fundamental properties of materials and technological processes.	The student is able to select and apply appropriate analytical, simulation, and experimental methods for the characterization of water quality, evaluation of water treatment efficiency, and monitoring of closed-loop water systems in technological processes. The student can interpret physicochemical measurement results and analyze the efficiency of water recovery and recycling processes using modern analytical tools and equipment.	[SU4] Assessment of ability to use methods and tools [SU5] Assessment of ability to present the results of task
	[K6_W03] Has knowledge of materials science and can relate the properties of materials with their structure and composition, knows the theoretical description of phenomena occurring in materials subjected to external factors.	The student understands the relationships between the composition, structure, and properties of materials used in water treatment, separation, and recovery technologies, and recognizes the influence of chemical, physical, and environmental factors on the durability and performance of these materials. The student possesses knowledge of the phenomena occurring in materials applied in filtration, sorption, membrane treatment, and resource recovery processes from industrial water and wastewater streams.	[SW1] Assessment of factual knowledge

Subject contents

Course content – lecture

1. **Introduction to the circular economy in the context of water**
2. **Hydrology and the natural water cycle**
3. **EU and Polish water policy**
4. **Water sources and wastewater streams in materials-related processes**
5. **Water treatment and purification methods**
6. **Closed-loop and cascading systems**
7. **Resource recovery from industrial wastewater**
8. **Urban water systems and green-blue infrastructure**
9. **Digitalization and modeling in water management**
10. **Environmental and economic assessment**
11. **Examples and case studies**
12. **Social aspects and project management**
13. **Trends and innovations**

Course content – seminar

The seminar classes are based on active student participation. Students prepare individual or group presentations/projects and discuss the obtained results. Proposed topics include:

1. **Analysis of water streams in a selected materials manufacturing process**
2. **Design of a water reuse system for a small-scale facility**
3. **Assessment of the water footprint of a selected product**
4. **Constructed wetlands as a method of water treatment and recycling**
5. **Recovery of phosphorus and nitrogen from wastewater sludge**
6. **Digital twins in water management**
7. **Comparison of water reuse regulations in selected EU countries**
8. **Social acceptance of reclaimed water**
9. **Modern membrane technologies**
10. **Water in the city**

Prerequisites and co-requisites

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
Seminar	60.0%	30.0%
Written exam	60.0%	70.0%

Recommended reading

Basic literature

Zdzisław Mikulski Gospodarka wodna, Wydawnictwo Naukowe PWN, 1998

Rolf Gimbel, Martin Jekel, Rainer Liessfeld (red.) Podstawy i technologie uzdatniania wody, t. 12, tłum. polskie, Projprzem Eko 2020

Adam Chojnacki Technologia wody i ścieków, Wydawnictwo Naukowe PWN, 1972

Praca zbiorowa pod red. A. Masłonia Nowoczesne technologie oczyszczania wody i ścieków, SeidelPrzywecki, 2019

Supplementary literature

A. K. Khajuria, R. R. Rajput Circular economy education approaches to water use in the industrial sector, *Frontiers in Environmental Science*, 2025, DOI 10.3389/fenvs.2025.1635079.

M. Ganesapillai i in. Beyond the flush: a review of wastewater circular systems, *npj Clean Water* 9 (2026) 31, DOI 10.1038/s41545-026-00557-8.

P. Gomes i in. Circular economy: water quality assessment for irrigation purposes in a constructedwetland scenario, *Scientific Reports* 16 (2026) 4545, DOI 10.1038/s41598-025-34161-6.

eResources addresses

Example issues/ example questions/ tasks being completed	1. Design a simplified closed-loop water system for a selected industrial process (e.g., plastics manufacturing or metal processing), including possibilities for water reuse and recovery. 2. Compare selected water treatment technologies (membrane filtration, adsorption, biological processes, photocatalysis) in terms of efficiency, cost, and environmental impact. 3. Evaluate the potential for resource and energy recovery from industrial wastewater or sewage sludge, including phosphorus, nitrogen, metal recovery, or biogas production. 4. Analyze the impact of European regulations related to water reuse (e.g., EU Regulation 2020/741) on the development of circular water management in industry and urban systems. 5. Propose the application of digital tools (SCADA, IoT, digital twins) for monitoring and optimizing water consumption and process efficiency in industrial facilities.
Practical activites within the subject	Not applicable

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