GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Wastewater Engineering, PG_00071941						
Field of study	Circular economy and water management						
Date of commencement of studies	October 2026		Academic year of realisation of subject	2026/2027			
Education level	second-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	1		Language of instruction	English			
Semester of study	1		ECTS credits	4.0			
Learning profile	general academic profile		Assessment form	exam			
Conducting unit	Faculty of Civil and Environmental Engineering -> Faculties of Gdańsk University of Technology						
Name and surname of lecturer (lecturers)	Subject supervisor		prof. dr hab. inż. Jacek Mąkinia				
	Teachers						
Lesson types	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	30.0	15.0	15.0	0.0	0.0	60
	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	60		4.0	36.0	100	
Subject objectives	Students get acquainted with techniques for the estimation of wastewater flows, characterization of wastewater quality as well as fundamental understanding of principal unit operations and processes used for wastewater treatment, especially those processes used for biological nutrient removal and sludge handling. Each student prepares a preliminary design of an advanced wastewater treatment plant (ATV A131) and optimizes the design using a computer simulation program						

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K7_U05] evaluates the correctness, efficiency, and impact of various solutions and processes in water management and circular systems, taking into account technical, economic, environmental, and social criteria, including sustainable development standards.	Student is able to plan and carry out laboratory experiments in order to evaluate the efficiency of wastewater treatment and sewage sludge disposal.	[SU1] Assessment of task fulfilment [SU4] Assessment of ability to use methods and tools
[K7_W01] identifies in a comprehensive manner the phenomena and processes related both to water management and the circular economy, including the cycles of water, energy, and materials, as well as their connections with environmental and technical systems, while indicating reliable sources of knowledge and information relevant to the analyzed issues.	Student recognizes, specifies and describes wastewater treatment technologies and sludge disposal technologies. Characterizes mathematical models of the processes.	[SW1] Assessment of factual knowledge
[K7_W05] demonstrates knowledge of the principles for evaluating the efficiency, reliability, and environmental impact of solutions in water management and circular economy systems, taking into account technical, economic, and environmental criteria.	Student recognizes, specifies and describes wastewater treatment technologies and sludge disposal technologies. Characterizes mathematical models of the processes.	[SW1] Assessment of factual knowledge
[K7_K01] makes competent and ethical decisions by analyzing knowledge and expert opinions.	Student recognizes, specifies and describes wastewater treatment technologies and sludge disposal technologies. Characterizes mathematical models of the processes.	[SK2] Assessment of progress of work

Subject contents

Course content – lecture

Wastewater sources and flows. Wastewater characterization based on physical and biodegradation criteria. Preliminary treatment unit operations (screens, grit chambers, primary clarifiers). Biological processes (suspended growth vs. attached growth) for wastewater treatment. Principles of biological nutrient removal (nitrification, denitrification, enhanced biological phosphorus removal). Implementation of biological nutrient removal processes in mainstream and sidestream treatment lines. Secondary clarifiers. Advanced treatment processes (tertiary treatment, physical-chemical treatment). Sludge handling processes (thickening, anaerobic vs. aerobic digestion, dewatering). Mathematical models of wastewater treatment processes.

Course content – exercises

Practical techniques for the estimation of wastewater flows, characterization of wastewater quality as well as fundamental understanding of principal unit operations and processes used for wastewater treatment, especially those processes used for biological nutrient removal and sludge handling. Each student prepares a preliminary design of an advanced wastewater treatment plant (ATV A131) and optimizes the design using a computer simulation program

Course content – laboratory

Laboratory testing in wastewater analysis and treatment

Prerequisites and co-requisites

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
Laboratory (report)	60.0%	10.0%
Exam	50.0%	70.0%
Project	60.0%	20.0%

Recommended reading

Basic literature	1. Metcalf and Eddy, Inc. (2003). *Wastewater Engineering, 4th Edition*. McGraw Hill, New York. 2. Grady, C.P.L., Daigger G.T. and Lim H.C. (1999). *Biological Wastewater Treatment. Second Edition, Revised and Expanded*. Marcel Dekker, New York. 3. Henze M., Harremoës P., Jes la Cour J., Arvin E. (1995). *Wastewater Treatment. Biological and Chemical Processes*. Springer-Verlag Berlin.
Supplementary literature	Not applied.
eResources addresses	

Example issues/ example questions/ tasks being completed	1. How can the wastewater flowrate data be analyzed? 2. Flowrates for the design and operation of wastewater treatment facilities. 3. What are the key components of wastewater and their typical concentrations? 4. Draw a typical treatment system for municipal wastewater. What are the typical removal efficiencies of most common constituents at each stage of treatment? 5. Physical characterization of wastewater vs. characterization based on the biodegradability criteria. 6. Briefly describe processes used for preliminary and mechanical treatment (schematic diagrams, dimensions, design considerations). 7. Principles of bacterial growth in activated sludge systems. 8. Nitrogen cycle in wastewater treatment plants. 9. Briefly describe the nitrification process (reaction, microorganisms involved, factors influencing process kinetics). 10. Briefly describe the denitrification process (reaction, microorganisms involved, factors influencing process kinetics). 11. Briefly describe enhance biological P removal (principle, microorganisms involved, factors influencing process kinetics). 12. Types of bioreactors in terms of hydrodynamic conditions (including the responses to tracer dosing) and wastewater feeding. 13. Briefly describe and compare common systems for N removal. 14. Principles of the design and operation of modern BNR activated sludge systems (show typical examples of BNR systems for combined N and P removal) 15. Advantages and disadvantages of computer simulation of wastewater treatment processes. 16. How can the settling characteristics of activated sludge be determined. 17. Solids mass balances for the clarifier. 18. How can the zone (hindered) settling velocity be determined? 19. Compare primary and secondary clarifiers (construction, design parameters). 20. General characteristics of membrane processes for advanced wastewater treatment. What are the types of membrane modules? 21. Draw a schematic layout of the sludge handling processes in wastewater treatment plants. Briefly describe each unit process. 22. What is sludge stabilization and processes used for this purpose? 23. Major biochemical processes occurring in anaerobic digesters (flowsheet) 24. Brief characteristics of mesophilic anaerobic digestion 25. Brief characteristics of thermophilic anaerobic digestion 26. Factors that impacts sludge dewatering 27. Briefly describe methods of sludge dewatering 28. Management strategies for treatment of sludge digester liquors - Inclusion of sidestream treatment in activated sludge systems 29. How can phosphorus be recovered from the sludge digestion liquors? 30. Briefly describe the anammox process (reaction, microorganisms involved, factors influencing process kinetics).
Practical activites within the subject	Not applicable

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