GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	WASTEWATER ENGINEERING, PG_00044127		
Field of study	Environmental Engineering		
Date of commencement of studies	October 2024	Academic year of realisation of subject	2024/2025
Education level	second-cycle studies	Subject group	Optional subject group Subject group related to scientific research 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	2	ECTS credits	4.0
Learning profile	general academic profile	Assessment form	exam
Conducting unit	Faculty of Civil and Environmental Engineering		
Name and surname of lecturer (lecturers)	Subject supervisor	prof. dr hab. inż. Jacek Mąkinia	
	Teachers		

Lesson types and methods of instruction	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	30.0	15.0	0.0	15.0	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	5.0	35.0	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_U13] can integrate knowledge in the areas of sanitary engineering, automatics, electronics, computer science, chemistry, biology and other disciplines in the formulation and solving tasks related to the design or modeling of sanitary systems and their components, using a systematic approach including non-technical aspects (including economic and legal)	Student incorporates the knowledge obtained from different fields to solve problems. Student utilizes the knowledge from related fields. Student takes into account non-technical aspects of designing.	[SU3] Assessment of ability to use knowledge gained from the subject
[K7_W07] has an in-depth, structured and theoretical knowledge of municipal management, including water treatment and water renewal technologies, various types of wastewater treatment technologies, including landfill leachate, sewage sludge treatment technologies; knowledge of natural methods used in water and wastewater treatment or construction, functioning, operation and closure of waste landfills	Student recognizes, specifies and describes wastewater treatment technologies and sludge disposal technologies. Characterizes mathematical models of the processes.	[SW1] Assessment of factual knowledge
[K7_U14] can technically and economically analyze and evaluate the solutions and functioning of facilities and systems in the sanitary engineering or flood protection, water intakes and water infrastructure or water and wastewater treatment plants; can assess the suitability and potential of using new achievements in materials, fixtures, devices and methodologies for designing and modeling the analyzed technical infrastructure and industrial objects, including innovative solutions	Student is able to evaluate the operation of wastewater treatment systems.	[SU2] Assessment of ability to analyse information
[K7_U07] can plan and carry out laboratory and field experiments leading to assessment of the efficiency of water treatment, waste water treatment, waste management and sewage sludge management	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_U12] can design: developed water and sewage system, complex heat source, pool water treatment technology, mechanical ventilation installation or underground water intake, drainage of urban water catchment, reservoir control system during flood seizure or water treatment technology, domestic waste water treatment plant	Student prepares a project of a wastewater treatment plant.	[SU4] Assessment of ability to use methods and tools

Subject contents

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.

Prerequisites and co-requisites

Assessment methods and criteria

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

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	Adresy na platformie eNauczanie:
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).	
Work placement	Not applicable	