GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	WASTEWATER ENGINEERING, PG_00060005		
Field of study	Environmental Engineering		
Date of commencement of studies	February 2023	Academic year of realisation of subject	2023/2024
Education level	second-cycle studies	Subject group	Obligatory subject group in the field of study 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	38.0	103

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_U10	Student is able to plan and carry out laboratory experiments in order to evaluate the efficiency of wastewater treatment and sewage sludge disposal.	[SU4] Assessment of ability to use methods and tools [SU1] Assessment of task fulfilment
K7_U11	Student is able to plan and carry out laboratory experiments in order to evaluate the efficiency of wastewater treatment and sewage sludge disposal.	[SU4] Assessment of ability to use methods and tools [SU1] Assessment of task fulfilment
K7_W07	Student recognizes, specifies and describes wastewater treatment technologies and sludge disposal technologies. Characterizes mathematical models of the processes.	[SW1] Assessment of factual knowledge
K7_U07	Student is able to plan and carry out laboratory experiments in order to evaluate the efficiency of wastewater treatment and sewage sludge disposal.	[SU4] Assessment of ability to use methods and tools [SU1] Assessment of task fulfilment
K7_U12	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
Project	60.0%	20.0%
Exam	50.0%	70.0%
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: Wastewater Engineering 2023/24 (Environmental Engineering, II stopnia, stacjonarne, II semestr) - Moodle ID: 34829 https://enauczanie.pg.edu.pl/moodle/course/view.php?id=34829

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