GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Modeling Methodologies for the Environment, PG_00038254						
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	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	5.0			
Learning profile	general academic profile		Assessment form	exam			
Conducting unit	Department of Hydraulic Engineering -> Faculty of Civil and Environmental Engineering						
Name and surname of lecturer (lecturers)	Subject supervisor		dr hab. inż. Piotr Zima				
	Teachers						
Lesson types and methods of instruction	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	30.0	30.0	0.0	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		5.0	60.0		125
Subject objectives	Understanding the processes that affect the migration and transformation of pollutants in the environment (with particular emphasis on surface waters). Classes relate to the basics and principles of building water quality models and are used to show how these models can be used to solve problems in environmental engineering.						

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)	The student has broadened and deep knowledge in some areas of mathematics, including methods for modeling water behavior in natural and artificial systems, migration of pollutants and description of self-cleaning processes. He knows the impact of these processes on economic conditions	[SU4] Assessment of ability to use methods and tools
[K7_W01] has broadened and deepened knowledge of selected mathematics sections, including statistics components and optimization methods, and mathematical and numerical methods necessary for: 1) modeling and analysis of water supply systems and their physical phenomena; 2) description and analysis of flood protection systems; 3) functional analysis, optimization and reliability of sanitary engineering systems; 4) description of phenomena related to the flow of water in the environment, in pipes and open channels, filtration, migration of pollutants	The student has broadened and deep knowledge in some areas of mathematics, including statistics, and in particular the analysis of error and measurement uncertainty	[SW1] Assessment of factual knowledge
[K7_U06] can use the known mathematical methods and models, if needed, to modify them, for: analysis and design of water systems and their components or water flows, migration of pollutants or water and wastewater treatment and sewage sludge handling	Student is able to develop a functional method to describe the processes of migration of pollutants and their removal in problems related to the treatment of water and wastewater and treatment of sewage sludge	[SU2] Assessment of ability to analyse information
[K7_W06] has deepened, structured and theoretical knowledge related to hydraulics used in the construction, operation, operation of networks and plumbing, sewage, heating, ventilation or water treatment plants and wastewater treatment facilities	The student knows and understands the methods of modeling transport and pollution changes characteristic for water supply and sewage networks, as well as optimization and reliability of sewage treatment systems	[SW1] Assessment of factual knowledge
[K7_W04] knows the basic automation methods, techniques, tools and systems used to solve complex engineering tasks in modeling, optimization and control of processes, objects and systems in environmental engineering	The student has broadened and deep knowledge in the field of automation, including solving complex engineering tasks in the field of modeling, optimization and process control	[SW1] Assessment of factual knowledge

Subject contents

Lecture
Control volumes and mass balances. Systems with full and incomplete mixing. Advection/dispersion transport. Kinematic mixing. Chemical equilibrium and mass behavior. Chemical kinetics and partitioning. Gas exchange at the air-water interface. Sedimentation. Biodegradation and kinetics of microbial growth. Preservation of dissolved oxygen. Eutrophication and heat budget. Migration of pollutants in rivers, lakes and estuaries. Water quality models (WASP, QUAL2K, Aquatox, EPD-RIV1, IWA RWQM No. 1).
Tutorials
Analytical solutions of advection-diffusion equations for various boundary conditions - excercises in Excel.
Group project on modeling of wastewater flow through the bioreactor - ASM 2d model

Prerequisites and co-requisites

Knowledge of basic numerical methods

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
exercises to be carried out at home	50.0%	20.0%
final test (60 min)	50.0%	80.0%

Recommended reading	Basic literature	Chapra, S. (1997). *Surface Water Quality Modeling*, McGraw Hill or (Waveland Press, 2008).
	Supplementary literature	Thomann R.V. and Mueller J.A. (1987). *Principles of Surface Water Quality Modeling and Control*. Harper & Row Publ. Sawicki J.M., *Migracja zanieczyszczeń*, Wyd. PG, Gdańsk 2003. Adamski W., *Modelowanie systemów oczyszczania wód*, PWN, Warszawa 2002.
	eResources addresses	Adresy na platformie eNauczanie:
Example issues/ example questions/ tasks being completed	1. Advantages and disadvantages of computer simulation 2. Model describing the growth of microorganisms and consumption of substrate 3. Equations describing the sedimentation process 4. Streeter-Phelps equation 5. A model describing the eutrophication process in the aquatic environment	
Work placement	Not applicable	