GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	NUMERICAL MODELING OF HYDROSYSTEMS, PG_00046022						
Field of study	Environmental Engineering						
Date of commencement of studies	October 2024		Academic year of realisation of subject	2025/2026			
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	2		Language of instruction	English			
Semester of study	3		ECTS credits	4.0			
Learning profile	general academic profile		Assessment form	assessment			
Conducting unit	Faculty of Civil and Environmental Engineering						
Name and surname of lecturer (lecturers)	Subject supervisor		dr hab. inż. Michał Szydłowski				
	Teachers						
Lesson types and methods of instruction	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		5.0	35.0		100
Subject objectives	The course provides students with knowledge on development and application of numerical models for water flow problems.						

Learning outcomes	Course outcome	Subject outcome	Method of verification
	[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 knowledge about the advantages and limitations of selected mathematical models of water flow. A new effect in the POWER program: The student knows the mathematical description of pollutant migration phenomena in groundwater and has a basic knowledge of the numerical methods used to solve the transport equations.	[SW1] Assessment of factual knowledge
	[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 has knowledge of the basic principles of the description of liquid movement in water systems.	[SW1] Assessment of factual knowledge
	[K7_W05] has basic knowledge in general construction or in water or sanitary or hydrotechnical or road construction; the impact of construction investments on the environment	Student has knowledge on application of mathematical modeling tools to asses impact of investments on groundwater.	[SW3] Assessment of knowledge contained in written work and projects
	[K7_U09] can choose tools (analytical or numerical) to solve engineering problems	Student is able to choose appropriate mathematical equations to describe the flow and transport of pollutants in water systems. A new effect within the POWER program: The student is able to select and evaluate tools for simulating the migration of pollutants in groundwater: MODPATH and MT3D programs.	[SU2] Assessment of ability to analyse information [SU3] Assessment of ability to use knowledge gained from the subject
	[K7_W09] has deepened, ordered, theoretically developed knowledge related to: hydrology, drainage, water management, flood protection or resource and water intake or water and sewage management	The student has knowledge of the interaction of flow streams between different water systems such as surface and groundwater.	[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	The student is able to choose appropriate numerical tools for modeling the flow and transport of pollutants in water systems and to analyze the results. A new effect within the POWER program: The student is able to simulate the transport of conservative pollutants in the aquifer for simple initial-bank conditions, using the MT3D program	[SU4] Assessment of ability to use methods and tools
Subject contents	Lecture: Role of computer tools in water resources management; mathematical models of flow and contaminant transport in hydrosystems, development of numerical model: preprocessing, simulation and postprocessing; verification, validation and calibration of the model, sensitivity analysis; numerical solution of partial differential equations: spatial discretization methods (finite difference, finite element, finite volume), time discretization methods (explicit and implicit schemes), solution of systems of linear and nonlinear algebraic equations; stability and accuracy of numerical methods, boundary conditions; solution strategies for coupled problems. Tutorials/ Laboratory: Application examples: formulation of the problem, preparing input data, problem solution using freely available numerical codes, visualization of the results.		
Prerequisites and co-requisites	no requirements		

<table>
<tr><td>Assessment methods and criteria</td><td colspan="2"><table>
<tr><th>Subject passing criteria</th><th>Passing threshold</th><th>Percentage of the final grade</th></tr>
<tr><td>Presentation of completed modeling exercises</td><td>50.0%</td><td>100.0%</td></tr>
</table></td></tr>
<tr><td rowspan="3">Recommended reading</td><td>Basic literature</td><td>Szymkiewicz R., Numerical modeling in open channel hydraulics.

Rushton K.R., Groundwater hydrology: conceptual and computational models.

Wang H., Anderson M.P., Introduction to groundwater modeling: finite difference and finite element methods.</td></tr>
<tr><td>Supplementary literature</td><td>MODFLOW software documentation http://water.usgs.gov/nrp/gwsoftware/modflow2005/modflow2005.html

HEC-RAS River Analysis System, Hydraulic Reference Manual, US Army Corps of Engineers, Davis 1997.

MT3DMS software documentation: https://hydro.geo.ua.edu/mt3d/mt3dmanual.pdf</td></tr>
<tr><td>eResources addresses</td><td>Adresy na platformie eNauczanie:</td></tr>
<tr><td>Example issues/ example questions/ tasks being completed</td><td colspan="2">Modeling of water flow in open channels.

Modeling of ground water flow.</td></tr>
<tr><td>Work placement</td><td colspan="2">Not applicable</td></tr>
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