GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	, PG_00060047		
Field of study	Environmental Engineering		
Date of commencement of studies	February 2023	Academic year of realisation of subject	2022/2023
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	Polish
Semester of study	1	ECTS credits	4.0
Learning profile	general academic profile	Assessment form	exam
Conducting unit	Department of Sanitary Engineering -> Faculty of Civil and Environmental Engineering		
Name and surname of lecturer (lecturers)	Subject supervisor	dr inż. Ryszard Orłowski	
	Teachers	dr inż. Maria Orłowska-Szostak dr inż. Ryszard Orłowski	

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	48.0	113

Subject objectives	The aim of the course is to acquaint the students with knowledge and abilities that enable to perform design and analytical works for the systems of water transport and distribution using the computer modeling of flows and storage of water in the system. Students are mastering new methods of the calibration of computer models using genetic algorithms among others. Apart from standard analyses of the system operation In computer performed analyses and design there are taking into account, among others, emergencies and fire situations.

Learning outcomes

Course outcome	Subject outcome	Method of verification
K7_W09	While performing design work, he uses extended and in-depth knowledge in the field of hydraulics, hydrology, computer modeling and design of water supply network; skillfully uses professional computer programs simulating of flows in the water supply systems to support design.	[SW3] Assessment of knowledge contained in written work and projects [SW1] Assessment of factual knowledge
K7_W06	Using computer modeling (with understanding the principles of water supply systems hydraulics), he comprehensively analyzes the functioning of water transport and distribution systems in situations of fire and possible system failures.	[SW3] Assessment of knowledge contained in written work and projects [SW2] Assessment of knowledge contained in presentation
K7_U03	Student can use the known computer models for solving analysis tasks or designing optimal water supply systems. He knows the methods of optimal and reliable control of large systems using appropriate computer models. The summary of these works is professional documentation.	[SU5] Assessment of ability to present the results of task [SU1] Assessment of task fulfilment
K7_U06	By solving complex engineering tasks in relation to water supply systems, it uses methods, techniques and tools of computer modeling (including professional software) as well as methods and algorithms that take into account optimization and reliability criteria and also environmental criteria	[SU4] Assessment of ability to use methods and tools [SU2] Assessment of ability to analyse information

Subject contents

LECTURES **1**. Structures of commercial computer programs for the mathematical modelling of flows in water supply systems and types of tasks as well as methods of solving them for the water transport and distribution system (STiDW)**:** a) task of the design type, b) task of redesigning the system (at different scopes of redesigning), c) tasks of the analysis of the existing system. **2**. Data preparation to the model of the existing system and the designed system. **3**. Calibration of the computer model of STiDW: various methods of calibration taking into account various assortment and character of made measurements and various methods of mathematical drawing up results of these measurements; discussions of achieved results of calibrations performed with different methods mentioned above. **4.** Discussing a number of hydraulic relations essential from the point of view of modelling of flows in the water supply system. **5**. The hydraulic drawings of the system of transport and distribution of water, made for the purposes of the computer modelling - examples of different types of pumping stations in water supply systems (at water intakes, zone stations, etc.); describing the water supply system in the form of the graph. **6**. Ways and scopes of practical using the computer modelling of flows in the case of existing system and of the designed system. **7**. Important engineering and design issues: -pressure zoning in water supply systems, -principles of control of flows and storing water using the pumps with the frequency speed drives (FSD) and the pressure reducing valves, - computer assisted dispatcher control of STiDW. **8**. Traditional and of new methods of solving sets of conservation equations describing flows in STiDW.

AUDITORIAL CLASSES Individual example cases of STiDW for distinguish students (maps, plans of water supply systems and the remaining data given as the first approximation) for using on design classes. Data preparation for the modelling carried out on the design classes. Principles/algorithm of the STiDW design with the method of variants analysis. The assortment and the manner of conducted versatile analyses of the defined/seted system.

LABORATORY Starting computer simulations of individual examples of water supply systems, prepared on auditorial classes. Redesigning of examples mentioned above with the method of the analysis of variants for achieving satisfactory results for thoroughly studied systems. Demonstrating (with the help and the participation of students) a number of other examples prepared earlier by the leading person; current discussion and analysis of achieved results of the simulations of individual examples.

Prerequisites and co-requisites

Mastered basic program with the subject "Water Supply". Knowledge of basis of hydraulics, description of flow in pressure conduits. Basic knowledge of numerical methods; general knowledge of methods of solving of sets of nonlinear equations.

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
design exercise	90.0%	55.0%
egzamin pisemny	70.0%	45.0%

Recommended reading	Basic literature	**1**. Walski T.M., Chase D.V., Savic D.A., Grayman W., Beckwith S., Koelle E. (2003). ADVANCED WATER DISTRIBUTION MODELING AND MANAGEMENT. Haestad Methods, Inc., HAESTAD PRESS, Waterbury, CT USA, First Edition, Second Printing. **2.**Kwietniewski M. (2013): GIS w wodociągach i kanalizacji. Wydawnictwo Naukowe PWN, Warszawa. **3**. Kulikowski J. L. (1986). Zarys teorii grafów zastosowania w technice. PWN, Warsaw, Poland. **4**. Mielcarzewicz E. W. (1998). Obliczanie systemów zaopatrzenia w wodę Arkady, Warsaw, Poland. **5**. Orłowska-Szostak M. Instrukcja opracowywania danych do symulacji programem EPANET opracowana przez prowadzącego zajęcia. Przekazana studentom w formie elektronicznej. **6**. Orłowski R. (2006). Comprehensive circumscribing of non-linearity cases of a water supply system with smooth flow control. Archives of Hydro-Engineering and Environmental Mechanics, IBW PAN, Poland, vol. 53 (1), 2006, pp. 7-30. **7**. Findeisen, Wł. (1985). Analiza systemowa. PWN, Warsaw, Poland. **8**. Orłowski, R. (1998). Projektowanie i analiza systemów wodociągowych z zastosowaniem modelowania matematycznego przepływów ustalonych. Gaz, Woda i Technika Sanitarna, PZITS, Poland, 7/98, 299 ÷ 307.
	Supplementary literature	**1**. Walski T. M. (1985). Analysis of Water Distribution Systems. Van Nostrand Reinhold Co. Inc., New York. **2**. Grabarczyk Cz. (1997). Przepływy cieczy w przewodach. Metody obliczeniowe. ENVIROTECH, Poznań 1997. **3**. Grabarczyk Cz.(2015). Hydraulika urządzeń wodociągowych Tom 1 i 2. WNT. **4**. Orłowski, R. (1997). Modelowanie matematyczne przepływów ustalonych w systemach wodociągowych. Zeszyty Naukowe Politechniki Gdańskiej, seria: Budownictwo Wodne. Nr 42, Gdańsk, Poland. **5**. Orłowski, R. (1999) Techniczne i ekonomiczne aspekty płynnego sterowania pracą pomp w systemach i instalacjach wodociągowych, kanalizacyjnych, ciepłej wody i c. o. Gaz, Woda i Technika Sanitarna, PZITS, Poland, 12/99, 449 ÷ 458.
	eResources addresses	Adresy na platformie eNauczanie:
Example issues/ example questions/ tasks being completed	The hydraulic drawings of the system of transport and distribution of water, made for the purposes of the computer modelling - examples of different types of pumping stations in water supply systems (at water intakes, zone stations, etc.); describing the water supply system in the form of the graph. Data preparation to the computer model of the working water supply system and of the water supply system being designed. Description of various methods and hydraulics of the zoning of the pressure in water supply systems. Elaboration of computer model of exemplary water supply system and using the model for designing correctly operating water supply system. Using the computer models in the optimum and reliable, computer assisted dispatcher control of the system of transport and distribution of water.	
Work placement	Not applicable	