



## Subject card

Subject name and code	Wastewater and water quality control, PG_00048793						
Field of study	Green Technologies						
Date of commencement of studies	October 2020	Academic year of realisation of subject			2022/2023		
Education level	first-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	3	Language of instruction			English		
Semester of study	6	ECTS credits			4.0		
Learning profile	general academic profile	Assessment form			exam		
Conducting unit	Department of Analytical Chemistry -> Faculty of Chemistry						
Name and surname of lecturer (lecturers)	Subject supervisor	dr inż. Weronika Hewelt-Belka					
	Teachers	dr inż. Ilona Kłosowska-Chomiczewska prof. dr hab. inż. Agata Kot-Wasik					
Lesson types and methods of instruction	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	30.0	0.0	15.0	0.0	15.0	60
	E-learning hours included: 0.0						
	Additional information: Traditional education - classes at the Department of Analytical Chemistry and in remote form <a href="https://enauczanie.pg.edu.pl/moodle/course/view.php?id=4366">https://enauczanie.pg.edu.pl/moodle/course/view.php?id=4366</a>						
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 main purpose of the subject is to present a full picture of water as an important natural resource: How water moves, how it becomes polluted in nature and through human activities, how it cleans itself in nature and how people purify water, how to recognize water pollution, monitor and analyze pollution, how to solve water pollution problems.						

Learning outcomes	Course outcome	Subject outcome	Method of verification
	[K6_K03] turns the attention to the prestige associated with the profession and professional solidarity properly understood, shows respect for others and concern for their welfare	The student understands the importance of prestige associated with their skills and profession	[SK3] Assessment of ability to organize work [SK5] Assessment of ability to solve problems that arise in practice
	[K6_U05] can formulate and solve engineering tasks analytical methods, simulation as well as experimental, able to apply knowledge of basic physics and mathematics to analyze the results of experiments, is able to analyze and assess existing technical solutions	The student has basic knowledge and skills in the field of analytical, simulation and experimental methods.	[SU1] Assessment of task fulfilment [SU2] Assessment of ability to analyse information
	[K6_W03] has a basic knowledge of soil, air and water pollutants, design and supervision of environmentally friendly technologies and technologies which do not produce waste, knows technology of cleaning and neutralization of industrial waste and wastewater management, has a basic understanding of the theoretical basis of methods and types of apparatus used in chemical analysis of environmental pollutants	The student learns the importance of environmental protection and has a basic knowledge of chemical and biological hazards for the soil compartment, with particular emphasis on the aquatic environment and anthropogenic factors	[SW2] Assessment of knowledge contained in presentation
	[K6_W04] is aware of the importance of environmental protection and has a basic knowledge of chemical and biological threats to the environment, with particular emphasis on anthropogenic factors, has a basic knowledge of knowledge of the principles of sustainable development as well as national and European environmental management conditions.	The student learns the importance of environmental protection and has a basic knowledge of chemical and biological hazards for the environment, with particular emphasis on the aquatic environment and anthropogenic factors	[SW2] Assessment of knowledge contained in presentation

Subject contents	<p>Introduction to WWQC general info. Basics repetition: water molecule, physics and chemistry of water; the hydrological cycle.</p> <p>Wprowadzenie do przedmiotu PiTMOW - ogólne informacje, zasady zaliczania. Powtórzenie podstaw: budowa cząsteczki wody, właściwości fizyko-chemiczne wody; cykl hydrologiczny.</p> <p>Transport Processes in the Environment. Boundary layers in water environment, dissolution, sediment-water exchange, air-water exchange and particle transport (Henry's Law constant, water-particles partition coefficient <math>K_p</math>, partition coefficient octanol-water <math>K_{ow}</math>, sediment-water partition coefficient, bioaccumulation factor BAF, bioconcentration factor BCF, biomagnification factor, biota-sediment accumulation factor BSAF).</p> <p>Procesy transportowe w środowisku. Warstwy graniczne, rozpuszczanie, mieszka wód, wymiana powietrze-woda i transport cząstek (Prawo Henry'ego, współczynnik podziału oktanol-woda <math>K_{ow}</math>, współczynnik podziału osad-woda, współczynnik bioakumulacji BAF, współczynnik biokoncentracji BCF, współczynnik biomagnifikacji/biowzbogacania, współczynnik akumulacji biota-osadów BSAF)</p> <p>Human impact on water resources. Part 1: Eutrophication; acidification &amp; metal speciation.</p> <p>Wpływ człowieka na zasoby wodne. Część 1: Eutrofizacja; zakwaszanie i specjacja metali.</p> <p>Human impact on water resources. Part 2: Pollution caused by organic compounds. POP's cycling.</p> <p>Wpływ człowieka na zasoby wodne. Część 2: Zanieczyszczenia spowodowane przez związki organiczne. Migracja TZO.</p> <p>New emerging pollutants in aquatic ecosystem (pharmaceuticals, hormones, microplastics, personal care products, flame retardants, etc).</p> <p>Sea water environment.</p> <p>Nowo pojawiające się zanieczyszczenia w ekosystemie wodnym (farmaceutyki, hormony, mikrodrobiny plastiku, Środki higieny osobistej, związki opóźniające proces palenia, itp).</p> <p>Środowisko wody morskiej.</p> <p>Parameters of natural waters : organoleptic parameters, physical and chemical parameters, microbiological parameters, toxic compounds - Polish and international regulation.</p> <p>Podstawowe substancje i grupy zanieczyszczające wody. Parametry określające jakość wody: organoleptyczne, fizyczne i chemiczne zanieczyszczenia, parametry mikrobiologiczne, toksyczne zanieczyszczenia regulacje prawne w Polsce i na świecie.</p> <p>Water resources in Poland. Classification of water quality in Poland. Characteristics of natural waters (surface, underground and rainwater). Water classification systems based on the quality standards of aquatic ecosystems or with maximum limits on pollutant emissions. Saprobic system. Water quality monitoring systems.</p> <p>Zasoby wodne. Gospodarka wodna w Polsce. Bilans wodny dla Polski w roku średnim. Sposoby zmniejszania deficytu wody. Charakterystyka wód naturalnych (wody powierzchniowe, podziemne i opadowe). Systemy klasyfikacji wód oparte o standardy jakości ekosystemów wodnych lub o maksymalne limity emisji zanieczyszczeń. System saprobowy. Systemy monitoringu jakości wód.</p> <p>Selfpurification of natural water; physical, chemical and biological mechanisms of self-purification processes. Mechanism of biodegradation under aerobic and anaerobic conditions. Water intake.</p> <p>Samooczyszczanie się wód powierzchniowych i podziemnych; mechanizmy fizyczne, chemiczne i biologiczne procesów samooczyszczania. Mechanizm biodegradacji w warunkach tlenowych i beztlenowych.</p> <p>Water treatment technology. Mechanical &amp; physical treatment. Chemical treatment &amp; disinfection.</p>
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	<p>Technologie uzdatniania wody. Procesy fizyczne, chemiczne i biologiczne. Dezynfekcja.</p> <p>Introduction to waste water: waste water characteristics. Waste water treatment: mechanical, chemical processes, biological processes.</p> <p>Charakterystyka ścieków. Oczyszczanie ścieków w oczyszczalniach technicznych: procesy fizyczne, fizykochemiczne, chemiczne oraz biologiczne. Dobór technologii oczyszczania ścieków w zależności od właściwości usuwanych zanieczyszczeń.</p> <p>Removal of suspended (mineral and organic) and dissolved (organic and biogenic) pollutants. Sewage treatment technology. Classic biological wastewater treatment systems using activated sludge and biological deposits.</p> <p>Usuwanie substancji zawieszonych (mineralnych i organicznych) i rozpuszczonych (organicznych i biogennych). Urządzenia do oczyszczania ścieków. Klasyczne systemy biologicznego oczyszczania ścieków metodą osadu czynnego i ziół biologicznych.</p> <p>Natural methods of water protection. Ways of preventing water pollution: closed water systems in industry and wastewater treatment (1h). Rain water characteristics, management and utilization (1h)</p> <p>Naturalne metody ochrony wody: roślinne strefy buforowe, rekultywacja zanieczyszczonych zbiorników wodnych, roślinne oczyszczalnie ścieków. Sposoby zapobiegania zanieczyszczeniu wód: stosowanie zamkniętych obiegów wody w przemyśle oraz oczyszczanie ścieków (1h). Charakterystyka, zarządzanie i wykorzystanie wody deszczowej (1h).</p> <p>Methods of evaluation of water quality. Part 1: Sampling. Sample storage and preservation. Sample pre-treatment before final analysis.</p> <p>Metody badania jakości wody. Część 1: Pobieranie próbek. Transport i przechowywanie próbek. Wstępne przygotowanie próbek przed analizą.</p> <p>Methods of evaluation of water quality. Part 2: Measurements with analytical techniques.</p> <p>Metody badania jakości wody. Część 2: Metody analityczne.</p>														
Prerequisites and co-requisites	Basic knowledge - Environmental Chemistry and Analytical Chemistry														
Assessment methods and criteria	<table border="1"> <thead> <tr> <th data-bbox="453 1344 794 1373">Subject passing criteria</th> <th data-bbox="799 1344 1141 1373">Passing threshold</th> <th data-bbox="1145 1344 1484 1373">Percentage of the final grade</th> </tr> </thead> <tbody> <tr> <td data-bbox="453 1379 794 1408">seminars - test and presentations</td> <td data-bbox="799 1379 1141 1408">60.0%</td> <td data-bbox="1145 1379 1484 1408">20.0%</td> </tr> <tr> <td data-bbox="453 1415 794 1462">lab. experiments - tests and reports</td> <td data-bbox="799 1415 1141 1462">60.0%</td> <td data-bbox="1145 1415 1484 1462">20.0%</td> </tr> <tr> <td data-bbox="453 1469 794 1498">lectures - exam</td> <td data-bbox="799 1469 1141 1498">60.0%</td> <td data-bbox="1145 1469 1484 1498">60.0%</td> </tr> </tbody> </table>			Subject passing criteria	Passing threshold	Percentage of the final grade	seminars - test and presentations	60.0%	20.0%	lab. experiments - tests and reports	60.0%	20.0%	lectures - exam	60.0%	60.0%
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Recommended reading	<p>Basic literature</p> <p>Supplementary literature</p> <p>eResources addresses</p>	<ol style="list-style-type: none"> <li data-bbox="804 1516 1484 1630">1. <a href="#">New horizons and challenges in environmental analysis and monitoring, praca zbiorowa pod red. J. Namieśnika, W. Chrzanowskiego, P. Szpinek, wydawca: Centrum Doskonałości Analityki i Monitoringu Środowiskowego (CEEAM), Wydział Chemiczny PG, Gdańsk 2003</a></li> <li data-bbox="804 1637 1484 1704">2. P. Konieczka, J. Namieśnik, Quality assurance and quality control in the analytical chemical laboratory: a practical approach, CRC Press, 2009</li> <li data-bbox="804 1711 1484 1756">3. Analytical measurements in aquatic environments, ed. J. Namieśnik, P. Szefer, CRC Press, 2009</li> <li data-bbox="804 1762 1484 1830">4. Water and Wastewater Analysis. P. Kubica, K. Wilczewska, A. Jakimska, A. Kot-Wasik, A. Wasik A. Gdańsk: GUT Publishing House, 2014</li> </ol> <p>Resources available in the form of scientific e-collections in GUT databases</p>													

<p>Example issues/ example questions/ tasks being completed</p>	<ol style="list-style-type: none"> <li>1. Which analytical techniques are used in water quality analysis? Specify three techniques and three analytes that can be determined with their use.</li> <li>2. Describe the eutrophication, what are its causes and effects?</li> <li>3. List and describe types of contaminations occurring in the aquatic environment.</li> <li>4. Specify natural processes that influence the composition of water and describe one of them in details.</li> <li>5. Specify and describe sources of new emerging contaminants in the aquatic environment.</li> <li>6. What is the self-purification of water? Describe the physical processes supporting the self-purification of water.</li> <li>7. Explain the following concepts related to water resources: gross water resources, inviolable flow, available resources, water exploitation index.</li> <li>8. What are the coastal ecotones? How should one develop such an ecotone to provide its efficiency?</li> <li>9. Compare slow and rapid filters due to their construction, functions and work cycle.</li> <li>10. What are the principals of process of biological nitrogen removal from wastewater? Describe the stages of the process and what are the necessary conditions for each of these stages?</li> </ol>
<p>Work placement</p>	<p>Not applicable</p>