GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	, PG_00037594						
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		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	3		Language of instruction		English		
Semester of study	6		ECTS credits		4.0		
Learning profile	general academic profile		Assessment form		assessment		
Conducting unit	Department of Analytical Chemistry -> Faculty of Chemistry						
Name and surname of lecturer (lecturers)	Subject supervisor		prof. dr hab. inż. Piotr Konieczka				
	Teachers		prof. dr hab. inż. Piotr Konieczka dr inż. Tomasz Dymerski Chintankumar Padariya				
Lesson types and methods of instruction	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	15.0	0.0	30.0	0.0	0.0	45
	E-learning hours included: 0.0						
	Additional information: Lecture: https://enauczanie.pg.edu.pl/moodle/course/view.php?id=4511 Laboratory: https://enauczanie.pg.edu.pl/moodle/course/view.php?id=4544						
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	45		15.0	40.0	100	
Subject objectives	Acquainting with the methods of monitoring and purification technologies used in air protection						

Learning outcomes	<table><tr><th>Course outcome</th><th>Subject outcome</th><th>Method of verification</th></tr><tr><td>[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</td><td>can use analytical methods and implement them during simulations and experiments, can evaluate technical solutions</td><td>[SU3] Assessment of ability to use knowledge gained from the subject [SU4] Assessment of ability to use methods and tools</td></tr><tr><td>[K6_U02] is able to operate equipment and perform typical analyzes of studies of environmental pollution, is able to carry out an analysis of typical environmental pollution and simple devices according to specification</td><td>has the ability to conduct environmental research and operating equipment, can create and update analytical methods and environmental protection technologies</td><td>[SU3] Assessment of ability to use knowledge gained from the subject [SU4] Assessment of ability to use methods and tools</td></tr><tr><td>[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</td><td>has broad knowledge in the field of environmental protection, green technologies and analytical methods, which include the use of modern measuring equipment</td><td>[SW1] Assessment of factual knowledge [SW3] Assessment of knowledge contained in written work and projects</td></tr><tr><td>[K6_U03] is able to use information and communication technologies relevant to the common tasks of engineering, is able to use known methods and mathematical-physical models to describe and explain phenomena and chemical processes</td><td>can use properly selected methods and devices enabling communication, knows how to use mathematical and statistical tools useful for the interpretation of chemical phenomena and processes</td><td>[SU2] Assessment of ability to analyse information [SU4] Assessment of ability to use methods and tools</td></tr></table>
Subject contents	ntroduction to air pollution control and the basics of atmospheric physics. Typical gaseous pollutants and their sources. Hazardous waste in the atmosphere. Units and standards. Horizontal and vertical movement in the atmosphere. Combustion processes. Dispersing of gaseous waste with piles. Models of air pollutant concentration. Emission mechanisms. Volatilization. Hydrolysis. Photodecomposition. Bio-degradation. Vapor pressure Henry's legal constant Diffusion coefficient Partition coefficients Organic pollutants and other issues VOC emission sources Natural sources Hydrocarbons and oxygen-containing compounds Organohalides, organic sulfur, organic compounds in the air VOC control systems: adsorption, combustion, condensation VOC emission control membranes air pollution in Indoor Sources Sick building complex Indoor air pollution control Carbon monoxide Driving Radon: source, effect and reduction method Noise: source and effect Active and passive noise control Insulation Acoustic shielding of buildings, urban acoustics Emissions of solid pollutants (8 h) Fly ash, toxic metals , asbestos, radioactive particles, organic solids, source control, dust removal equipment: cyclones, gravity chamber, collector recirculation, various types of mechanical collectors, bag filters, electrostatic precipitators, scrubbers: Venturi, cyclone, impact packed tower . Mist Pads. Dry scrubbing. Selection of dust collectors. Control of sulfur oxides and H_2S. Sulfur and other impurities in fuels. Exhaust gas treatment systems. Dew point. Gas scrubbing systems with liquids. Absorption systems. Flue gas desulphurization processes after combustion: lime, limestone slurries (modification of formic acid), double alkali, bubble reactor, semi-dry rinsing, dry injection technologies (lime, carbonate or sodium bicarbonate). Magnesium FGD with a regeneration system. Regeneration processes: Bromine Technology, Wellman Lord (with sodium sulphite), Amine Absorbent Cansolv system. Ammonia scrubbing processes. Electron beam / ammonia process. Direct desulphurization of boilers and denitration. Fluidized bed combustion boilers. Mercury control options for coal power plants and incinerators. Removal of reduced sulfur compounds from crude oil and natural gas streams. Secondary furnace gases from smelters. Removal of H_2S from hydrocarbons. Control of nitrogen oxides (2h). Balance of NO and NO_2. Thermal, Hints and Fuel NO. Control of nitrogen oxide emissions from the burner and combustion modifications, by introducing combustion zones in furnaces, through post-flame treatment. NO_x removal by fluidized bed combustion, alkali injection into combustion chamber, methane injection. Desox and Denox process with active coke. Noxso regeneration technology with sodium carbonate. Cleaning of gases after combustion (4h). Waste gases and dust emissions from waste incineration plants. Difference to exhaust fossil fuel combustion. Toxins in fly ash and ash. Principles of combustion in controlled air. Single batch, intermittent work; air purification in mobile incinerators. Incineration of wet, dry and semi-dry harvesters. Control of air pollution from municipal, industrial and hospital incineration plants. Types of hot gas filters: electrostatic, candle, bags with stream conveyors. Schematic diagrams of the incinerator scrubber system. Removal of volatile groups of heavy metals, halogens and mineral acid vapors, inorganic salts and oxides, dioxins and furans. Fixed bed activated carbon adsorption systems. Removal of liquids from the collection of gases and aerosols. a-c. Calculation of chemical additives for flue gas desulphurization (FGD). 2. Standard methods of preparation of gas mixtures. 3 a-b. Preparation of standard gas mixtures. Calculations. 4. Scrubbers for the control of solid particles. 5. Emissions of motor vehicles. 6. Sources of radioactive pollution. 7. Radon - source effects and reduction methods. AND 1. Database of construction and safety materials for flue gas desulphurization (FGD) installations. 2. Selection of FGD materials in the database. 3. Monitoring local pollutants using a mobile monitoring station. 4. Instrumental analysis (GC-FID, GC-MS) of atmospheric and / or indoor air samples. 5. Air purifying equipment. Air purification methods.

<table>
<tr><td>Prerequisites
and co-requisites</td><td colspan="2"></td></tr>
<tr><td>Assessment methods
and criteria</td><td colspan="2">

Subject passing criteria	Passing threshold	Percentage of the final grade
Labs: tests and reports	60.0%	40.0%
Exam	60.0%	60.0%

</td></tr>
<tr><td rowspan="3">Recommended reading</td><td>Basic literature</td><td>1. R.A.Corbitt: Standard Handbook of Environmental Engineering, Mc Graw-Hill Co. N.York 1990. 2. A.M.Springer, D.Arceneaux: Alternative Air Emission Control Strategies, in Industrial 3. R.D.Ross ed.: Air Pollution and Industry, Van Nostrand Reinhold Co., N.York 1972. 4. O.Hutzinger ed.: The Handbook of Environmental Chemistry Vol.4 Part B, Air Pollution, Springer Verlag, Berlin 1989. 5. T.T. Shen, C.E. Schmidt, T.C.Card: Assessment and Control of VOC Emissions from Waste Treatment and Disposal Facilities, Van Nostrand Reinhold, N.York 1993. 6. Y.S. Matros, G.A. Bunimovich: Control of Volatile Organic Compounds by the Catalytic Reverse Process, Ind. Eng. Chem. Res. 34,1995, p.1630-1640 7. B.D.Eitzer: Emission of VOC from Municipal Solid Waste Composting Facilities, Environmental Science and Technology Vol.29, 1995, 896-902. 8. Noel de Nevers: Air Pollution Control Engineering, McGear-Hill, Inc., N.York 1995. 9. Sulphur Dioxide and Nitrogen Oxides in Industrial Waste Gases: Emission, Legislation and Abatment, D. van Velzen ed., Kluwert Academic Publishers, Dordrecht l99l.</td></tr>
<tr><td>Supplementary literature</td><td>1. S.E.Manahan: Environmental chemistry, Lewis Publ., 1993. 2. Environmental Control. Pulp and Paper Industry, ed. A.M.Sprirger, TAPPI Atlanta 1993, p.582-608. 3. K.V.Peinemann, K.Ohlrogge, J.Wind: Industrial Application of Membranes to Control VOC Emission, in Characterisation and Control of Odours and VOC in the Process Industries, Elsevier Science B.V., 1994, p.375-385. 4. L.Theodore: Air Pollution Control and Waste Incineration for Hospitals and other Medical Facilities, Van Nostrand Reinhold, N.York 1990. 5. Toxic Air Pollution Handbook, E.D. Patrick ed., Van Nostrand Reinhold, N.York 1994.</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">What are pros and cons of selective catalytic reduction (SCR)?What are the sources and environmental consequences of mercury emission?Describe the difference between the turbulent and laminar flow. How to estimate whether flow shall be mostly laminar or mostly turbulent?Calculate the air flow rate u1 [m/s] inside the chamber with a rectangular cross-section of a=1.5m and b=3.0m knowing that volumetric flow V=200 m3/minute.Describe the advantages and disadvantages of cyclone and scuber air dedusting systems.</td></tr>
<tr><td>Work placement</td><td colspan="2">Not applicable</td></tr>
</table>