COURSE DESCRIPTION CARD - SYLLABUS

Course name
Atmospheric Protection Engineering [S1IŚrod2>IOA]

Course

Field of study
Environmental Engineering

Year/Semester
3/5

Area of study (specialization)
–

Profile of study
general academic

Level of study
first-cycle

Course offered in
Polish

Form of study
full-time

Requirements
compulsory

Number of hours

Lecture
30

Laboratory classes
15

Other (e.g. online)
0

Tutorials
0

Projects/seminars
0

Number of credit points

4,00

Coordinators

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Lecturers

Prerequisites

Basic chemical processes with particular emphasis on the reaction of alkaline and acidic substances, oxidation and combustion reactions. Balancing chemical reactions. Compressible and incompressible fluid flows in ducts and open channels. Mass forces, friction forces. Intermolecular forces. Fundamentals of adsorption and absorption processes. Gas equation of state. 1st and 2nd laws of thermodynamics Measurements of temperature, pressure, gas flow. Solving simple tasks in fluid mechanics (gas) and thermodynamics Group (team) work skills. Awareness of the constantly supplement knowledge and skills improvements.

Course objective

Transfer of knowledge and skills about generation and reduction of air pollutant emissions from technological processes, including fuel combustion for energy purposes. Discussion of the primary and secondary methods of reducing pollutant emissions (including dedusting, desulfurization, reduction of nitrogen oxides and deodorization) based on the processes of adsorption, absorption, combustion and biodegradation.

Course-related learning outcomes

Knowledge:
1. The student has knowledge of the modern approach to environmental protection.
2. Understands the mechanism of air pollution formation in fuel combustion processes.
3. Knows and understands the basic primary and secondary reducing technologies of dust and gaseous air pollutants.
4. Knows the principles of designing the air pollution reduction system for selected technologies.
5. Has a basic understanding of the current Polish and EU legislation concerning emission and immission standards.
6. Knows and understands the processes determining air quality in an urban agglomeration.

Skills:
1. The student is able to present the place and importance of technical activities in air protection area.
2. Can calculate the drift and emission of air pollutants from basic technological processes.
3. Is able to design flue gas deducting and desulfurization system for medium power sources.
4. Can perform quantitative dust analysis.
5. Can measure concentrations of dust and gas pollutants in pipes.

Social competences:
1.The student understands the complexity of the technical and natural environment and the need for specialists cooperation from various fields in solving theoretical and practical problems.
2. Realizes that the protection of atmospheric air is a complex issue, the effective solution of which requires the cooperation of specialists in various fields.
3. Awares of the responsibility of an environmental protection specialist for the quality of life, especially in an urban agglomeration.
4. Recognizes the need to systematically improve and expand his knowledge and competences.
5. Learns teamwork

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Lectures:
Exam in the form of questions (and/or): open, calculation, drawing, test of various types. Grading scale: 0-50%: 2,0; 51-60%: 3,0; 61-70%: 3,5; 71-80%: 4,0; 81-90%: 4,5; 91-100%: 5,0. Bonus attendance: +0.5 grade for attendance at 10 lectures, +1.0 grade for attendance at 14 lectures (condition: minimum test score of 40%)
Project:
Weighted average of the following elements of classes: ongoing control of project implementation after each class (20%), oral project defense (40%), project evaluation (40%)
Laboratories:
Weighted average of preparation and commitment for in the exercise realization (50%) and evaluation of the exercise report (50%). The reports are handed to evaluation in at the next class. In the case of not submitting, the report grade is reduced by half a grade.

Programme content

Lectures:
1. Introduction to environmental protection, including air protection (historical background). Structure of the Earth's atmosphere, discussion of the processes taking place in it.
2. Air pollution and its sources. Basic concepts and definitions, e.g. drift, emission, immission, advection, acidification eutrophication, deposition, etc. Elements of legislation. The formation of pollutants mainly in the combustion process. General principles of technology selection.
3. Dust emission reduction processes: features and quantities describing dust, dust collection methods, construction and principle of operation of dust collectors.
4. Reduction of gas pollutants: basics of absorption and adsorption technologies, catalytic and non-catalytic combustion, biological processes (bio scrubbers, bio filters). Carbon capture.
5. Sulfur oxides mechanism of formation. Technologies of sulfur oxide reduction (desulfurization methods) and other acid pollutants: dry, semi-dry, wet and other methods.
6. Formation of nitrogen oxides: fuel, thermal and radical mechanism. Primary and secondary methods of reducing nitrogen oxide emissions, including low-emission burners, SCR and SNCR methods.
7. Volatile organic compounds and persistent organic compounds: definitions, mechanism of formation.

VOC and POP emissions reduction technologies.
8. Odors: discussion of the specifics of pollution. Fundamentals of olfactometry.
9. Reduction of heavy metal emissions, with particular emphasis on mercury.
Project:
Design activity conducted in two-person groups.
Subject: Design of a dry or semi-dry flue gas desulfurization technology with a dust removal system.
Laboratories:
Laboratory classes carried out in 3-5 people teams, depending on the size of the student group.
Subjects:
1. Dust sieve analysis - granulometric distribution.
2. Determination of absolute dust density and determination of bulk density.
3. Determination of the weight composition of dust grains using a sedimentation pipette.
4. Testing the efficiency of dust collectors.
5. Dust microscopic analysis.
6. Measurement of the concentration of oxygen, carbon monoxide and carbon dioxide

Course topics

none

Teaching methods

Lectures:
Informative lecture with elements of a conversational lecture; Problem lecture; Multimedia presentation;
Project:
Teamwork on projects; Case study discussion
Laboratories:
Experiment method; Discussion

Bibliography

Basic:
[1] Kościelnik B. Dąbrowski T. Podstawy ochrony atmosfery. Wydawnictwo Uczelniane Politechniki Koszalińskiej, 2016.
[2] Warych J. Oczyszczanie przemysłowych gazów odlotowych. WNT, 2000.
[3] Wielgosiński G., Zarzycki R. Technologie i procesy ochrony powietrza, PWN, 2018.
[4] Mielcarek P., Rzeźnik W. Odor emission factors from livestock production, Polish Journal of Environmental Studies 2015, 24 (1).
[5] Odpowiednie Rozporządzenia Ministra Środowiska oraz Dyrektywy UE.
[6] Wang L.K., Pereira N.C. Y-T Humg. Air Pollution Control Engineering, Springer, 2004.

Additional:
[1] J. Kośmider J., Mazur-Chrzanowska B., Odory.PWN, 2002.
[2] Bagieński Z. System ochrony powietrza , cz.1. PFP , 2003.
[3] Tomeczek J., Gradoń B., Rozpondek M., Redukcja emisji zanieczyszczeń z procesów konwersji paliw i odpadów, Wyd. Politechniki Śląskiej, 2009.
[4] Baltrenas P., Baltrenaite E.Sustainable Environmental Protection Technologies: Contaminant Biofiltration, Adsorption and Stabilization, Springer, 2021.

Breakdown of average student's workload

	Hours	ECTS
Total workload	100	4,00
Classes requiring direct contact with the teacher	60	2,50
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	40	1,50