

(faculty stamp)

## COURSE DESCRIPTION

Z1-PU7

WYDANIE N1

Strona 1 z 1

<b>1. Course title: LOW EMISSION COMBUSTION TECHNOLOGIES</b>		<b>2. Course code</b>		
<b>3. Validity of course description: since 2014</b>				
<b>4. Level of studies: 2<sup>nd</sup> cycle of higher education</b>				
<b>5. Mode of studies: intramural studies</b>				
<b>6. Field of study: POWER ENGINEERING/ ENVIRONMENTAL ENGINEERING</b>		<b>(FACULTY SYMBOL)</b>		
<b>7. Profile of studies: general academic</b>				
<b>8. Programme: Environmental engineering and clean technologies in power engineering and motorization</b>				
<b>9. Semester: 2</b>				
<b>10. Faculty teaching the course: Institute of Thermal Technology</b>				
<b>11. Course instructor: dr inż. Adam Klimanek</b>				
<b>12. Course classification: Specializations subject</b>				
<b>13. Course status: compulsory</b>				
<b>14. Language of instruction: English</b>				
<b>15. Pre-requisite qualifications: Basic knowledge of thermodynamics, heat and mass transfer, chemistry and fluid mechanics. Advised knowledge in fuels and combustion</b>				
<b>16. Course objectives: The aim of the course is to deliver knowledge on noxious substances formation in the course of combustion and on methods and technologies of emission abatement</b>				
<b>17. Description of learning outcomes:</b>				
Nr	Learning outcomes description	Method of assessment	Teaching methods	Learning outcomes reference code
1.	Student quotes main regulations related to emission of noxious substances	written exam	Lecture	K_W01, K_W17
2.	Student characterizes the emissions structure of main air pollutants	written exam	Lecture	K_W10, K_W16, K_U11, K_U24
3.	Student demonstrates broad knowledge of noxious substances formation mechanisms	written exam; evaluation of lab reports and exam	Lecture, Lab	K_W05, K_W11, K_W22, K_U11, K_U24
4.	Student is familiar with methods and knows basic parameters of primary and secondary emission reduction typical for energy and motorization sector	written exam; evaluation of lab reports and exam	Lecture, Lab	K_W17, K_W19, K_W22, K_U21, K_U11, K_U24
5.	Student is able to identify conditions (type of combustion technology, type of fuel, operating conditions) which cause a risk of pollutants formation	written exam; evaluation of lab reports and exam	Lecture, Lab	K_W16, K_W17, K_W22, K_U24
7.	Student is able to take measurements, analyze and interpret results of experiments related to emission control	evaluation of lab reports	Lab	K_W13, K_W21, K_U10, K_U21
<b>18. Teaching modes and hours</b>				
<b>Lecture / BA /MA Seminar / Class / Project / Laboratory</b>				
Lecture 30 h/ Laboratory 15 h				
<b>19. Syllabus description:</b>				
The course consists of lectures and labs. The following subjects are discussed during the lectures:				
<ul style="list-style-type: none"> <li>Importance of combustion in view of World and national primary energy needs</li> </ul>				

- Ecological noxiousness of combustion
- Primary and secondary contamination, main pollutants and emission sources, emission factors, regulations
- Mechanisms leading to formation and emission of nitrogen oxides (thermal, prompt, by means of N<sub>2</sub>O, fuel, formation of NO<sub>2</sub>), sulphur oxides, carbon monoxide, hydrocarbons, dioxins, furanes and particulate matter in the course of combustion
- In-situ methods and technologies of emission reduction of noxious substances (air and fuel staging, reburning, low NO<sub>x</sub> burners, LNCFS, SNCR, reduction of excess air ratio, reduction of temperature, mild combustion, oxyfuel combustion, fuel sorbent injection, catalytic combustion)
- Selected secondary methods of emission reduction of noxious substances (SCR, catalytic and thermal combustion and afterburning of lean mixtures, catalytic converters used in vehicles, charging, DPF, EGR)

Written exam is conducted to assess the acquainted knowledge.

The laboratory exercises are based on a series of experiments carried out by students and assisted by the instructors. The experiments are carried out in small groups. Students need to acquire knowledge of the examined processes, experimental facilities and procedures prior to the lab, based on materials provided by the instructors. Then students conduct the experiments and are expected to prepare reports from each experiment. The knowledge acquainted during the labs is further verified in a written exam. The subjects covered in the lab exercises include experimental investigations of: CO, NO and CO<sub>2</sub> emissions during gaseous fuel combustion, thermal afterburning of lean gaseous mixtures, fluidization process and operating parameters of combustion processes affecting formation and emission of noxious substances

**20. Examination: YES**

**21. Primary sources:**

1. R.K. Wilk, Low emission combustion, Wyd. Pol. Śl., Gliwice 2002
2. L.D. Smoot, Fundamentals of coal combustion for clean and efficient use, Elsevier, 1993
3. S.R. Turns, An Introduction to Combustion: Concepts and Applications, 2nd Edition, Mc Graw Hill, 2000
4. Chomiak J., Combustion a study in theory, fact and application, Gordon and Breach Science Publishers, 1990

**22. Secondary sources:**

1. J. Jarosiński, Techniki czystego spalania, WNT, 1996 (in polish)
2. W. Kordylewski (red) Spalanie i paliwa, I, II, III, IV wydanie, Pol. Wroc., 2005 (in polish)
3. J. Koniecznyński, Oczyszczanie gazów odlotowych, Wyd. Pol. Śl., Gliwice, 1993 (in polish)
4. J. Kuroпка, Oczyszczanie gazów odlotowych z zanieczyszczeń gazowych, Pol. Wroc., 1996 (in polish)
5. J. Więckowska, Katalityczno-adsorpcyjne odsiarczanie gazów, Pol. Wroc., 1994 (in polish)

**23. Total workload required to achieve learning outcomes**

Lp.	Teaching mode :	Contact hours / Student workload hours
1	Lecture	30/45
2	Classes	/
3	Laboratory	15/45
4	Project	/
5	BA/ MA Seminar	/
6	Other	5/10
	Total number of hours	50/100

**24. Total hours: 150**

**25. Number of ECTS credits: 5**

**26. Number of ECTS credits allocated for contact hours: 1.5**

**27. Number of ECTS credits allocated for in-practice hours (laboratory classes, projects): 2**

**26. Comments:**

Approved:

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(date, Instructor's signature)

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(date, the Director of the Faculty Unit signature)