Course title: **Sustainability Design Thinking**		
Programme: **Intelligent Energy for Environmental Protection**		Code: **1.1**
Type of course: **Module 1**	Course level: **II**	Semester: **III**
Form of classes: **Lecture, tutorials**	Number of hours per week/meeting: **1L, 1T**	Credit points**:** **2**
Education profile: **general academic**		Course language: **English**
Enrolment: **no**		

SYLLABUS

I. COURSE CHART

COURSE OBJECTIVES

C.1. to learn how to design products and the environments with consideration of space, form, environment, energy, economics and health
C.2. to acquire knowledge of methods and tools for creative problem solving

PRELIMINARY COURSE REQUIREMENTS FOR KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Skills of logical thinking and open mindset
2. Knowledge of the most pressing environmental issues
3. Knowledge of the principles for sustainable development and circular economy

LEARNING OUTCOMES

EU 1 - Student has the knowledge of tools and methods for designing products and environments in view to sustainability and circular economy
EU 2 - Student has the skills for designing products and environments with special consideration to natural resources, energy and waste

COURSE CONTENT

Form of classes - lectures	Hours
Introduction to the course	1
Human-centered design approach	2
Sustainable development, circular economy, zero waste concepts	3
Design thinking as a way of creative problem solution	2
Design thinking applied to the circular economy	3
Sustainable design of product and environments	3
Course summary	1

Form of classes - tutorials	Hours
Developing sustainable design ideas	3
Ideation	3
Prototyping	3
Testing	3
Pitching the ideas	3

COURSE STUDY METHODS

1. Lecture with multimedial presentations
2. Tutorial with workshop elements

METHODS OF ASSESMENT (F - formative; S - summative)

F1. Assessment of individual preparation to classes
F2. Assessment of working in the group

STUDENT WORKLOAD

Form of activity	Workload (hours)
Participation in lectures	**15 h**
Participation in classes	**15 h**
Laboratory	**- h**
Participation in project classes	**- h**
Participation in seminar	**- h**
Preparation course on e-learning	**- h**
Test	**- h**
Entrance test for laboratory classes	**- h**
Project's defence	**- h**
Exam	**- h**
Consultation hours	**5 h**
DIRECT TEACHING, hours/ ECTS	**35 h / 1,4 ECTS**
Preparation for tutorials	**15 h**
Preparation for laboratories	**- h**
Preparation for projects	**- h**
Preparation for seminars	**- h**
Preparation for e-learning classes	**- h**
Participation in e-learning classes	**- h**
Working on project	**- h**
Preparation for tests	**- h**
Preparation for exam	**- h**
SELF-STUDY, hours/ ECTS	**15 h / 0,6 ECTS**
TOTAL (hours)	**∑ 50 h**
TOTAL ECTS	**2 ECTS**

PRIMARY AND SUPPLEMENTARY TEXTBOOKS

Ingle B.R. Design thinking dla przedsiębiorców i małych firm. Potęga myślenia projektowego w codziennej pracy. Helion, 2015
Garcia R., Dacko S. Design Thinking for Sustainability. 2015; available from https://onlinelibrary.wiley.com/doi/abs/10.1002/9781119154273.ch25
Design Thinking. The Guidebook; available from http://www.rcsc.gov.bt/wp-content/uploads/2017/07/dt-guide-book-master-copy.pdf

SUBJECT COORDINATOR (NAME, SURNAME, E-MAIL ADDRESS)

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1. Krystyna Malińska, kmalinska@is.pcz.pl

Learning outcome	In relation to the learning outcomes specified for the field of study	Course objectives	Course content	Course study methods	Methods of assesment
EU 1	**K_U01, K_U02, K_U05, K_U06**	**C.1**	Lecture/ tutorials	**1**	**F1,**
EU 2	**K_K01**	**C1-C.2**	Lecture/ tutorials	**1,2**	**F1, F2**

II. OTHER USEFUL INFORMATION

1. All the information on the class schedule is posted on the student information board and online at: www.is.pcz.pl
2. The information about the consultation hours is provided to students on the first class meeting and posted online at www.is.pcz.pl
3. The information on course completion and grade is provided to students on the first class meeting.

Course title: **Talking about Environmental Challenges**		
Programme: **Intelligent Energy for Environmental Protection**		Code: **1.2**
Type of course: **Module 1**	Course level: **II**	Semester: **II**
Form of classes: **Tutorials**	Number of hours per week/meeting **2T**	Credit points: **2**
Education profile: **general academic**		Course language: **English**
Enrolment: **no**		

SYLLABUS

I. COURSE CHART

COURSE OBJECTIVES

C.1. to learn how to talk about complex scientific issues to non scientific audiences
C.2. to acquire knowledge of tools and techniques for communicating environmental issues to non scientific audiences

PRELIMINARY COURSE REQUIREMENTS FOR KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Skills of logical thinking and open mindset
2. Knowledge of the most pressing environmental issues and challenges

LEARNING OUTCOMES

EU 1 - Student has the knowledge of the methods and techniques to present and discuss issues related to the natural environment and current environmental challenges with non scientific audiences
EU 2 - Student has the skills for talking about complex scientific issues on environmental challenges to non scientific audiences

COURSE CONTENT

Form of classes - tutorials	Hours
Introduction to current environmental challenges	6
Communicating science: the basics and beyond	5
Storytelling to communicate science	5
Pitching ideas to non scientific audiences	6
Role-playing excercise to communicate scientific work	8

COURSE STUDY METHODS

1. Tutorial with workshop elements

METHODS OF ASSESMENT (F - formative; S - summative)

F1. Assessment of individual preparation to classes
F2. Assessment of working in the group

STUDENT WORKLOAD

Form of activity	Workload (hours)
Participation in lectures	**- h**
Participation in classes	**30 h**
Laboratory	**- h**
Participation in project classes	**- h**
Participation in seminar	**- h**
Preparation course on e-learning	**- h**
Test	**- h**
Entrance test for laboratory classes	**- h**
Project's defence	**- h**
Exam	**- h**
Consultation hours	**5 h**
DIRECT TEACHING, hours/ ECTS	**35 h / 1,4 ECTS**
Preparation for tutorials	**15 h**
Preparation for laboratories	**- h**
Preparation for projects	**- h**
Preparation for seminars	**- h**
Preparation for e-learning classes	**- h**
Participation in e-learning classes	**- h**
Working on project	**- h**
Preparation for tests	**- h**
Preparation for exam	**- h**
SELF-STUDY, hours/ ECTS	**15 h / 0,6 ECTS**
TOTAL (hours)	**∑ 50 h**
TOTAL ECTS	**2 ECTS**

PRIMARY AND SUPPLEMENTARY TEXTBOOKS

1. Heath C., Heath D. Made to stick. Why some ideas survive and others die. Random House 2008
2. Luna R.E. The art of scientific storytelling: transform your research manuscript using a step-by-step formula. 2013
3. Alley M. The Craft of Scientific Presentations: Critical steps to succeed and critical errors to avoid. Springer, 2003

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Learning outcome	In relation to the learning outcomes specified for the field of study	Course objectives	Course content	Course study methods	Methods of assesment
EU 1	**K_U03, K_U05, K_U12**	**C.1**	Tutorials	**1**	**F1**
EU 2	**K_U03, K_U05, K_U12**	**C.2**	Tutorials	**1,2**	**F1, F2**

II. OTHER USEFUL INFORMATION

1. All the information on the class schedule is posted on the student information board and online at: www.is.pcz.pl
2. The information about the consultation hours is provided to students on the first class meeting and posted online at: www.is.pcz.pl
3. The information on course completion and grade is provided to students on the first class meeting.

Course title: **Atmosphere protection and flue gas cleaning**		
Programme: **Intelligent energy for environmental protection**		Code: **2.1**
Type of course: **Module 2**	Course level: **II**	Semester: **II**
Form of classes: **lecture, laboratory**	Number of hours per week/meeting: **1L, 2Lab, E**	Credit points: **3**
Education profile: **general academic**		Course language: **English**
Enrolment: **no**		

SYLLABUS

I. COURSE CHART

COURSE OBJECTIVES

C.1. Understand and describe the environmental impact of combustion processes and related regulations.
C.2. Know and describe the flue gas cleaning processes for different combustion techniques.

PRELIMINARY COURSE REQUIREMENTS FOR KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge on the fundamentals of chemistry and combustion.
2. Ability for independent study of the literature and technical papers.

LEARNING OUTCOMES

EU 1 - Knowledge on the environmental impact of combustion processes.
EU 2 - Knowledge on flue gas cleaning processes.

COURSE CONTENT

Form of classes - lectures	hours
Introduction to Air Pollution. Environmental Effects of Air Pollution (Greenhouse effect. Smog. Acid rain. Stratospheric Ozone depletion). Legislation related to emissions reduction.	3
Low-stack emission.	3
Global warming. Carbon dioxide emission. Carbon dioxide removal technologies.	3
Reduction technologies: Nitrogen Oxides (SCR process for catalytic NOx reduction, SNCR process for non-catalytic NOx reduction).	1
Reduction technologies: Sulfur oxides (Flue gas desulphurisation, absorption processes, FBC).	2
Reduction technologies: particulate matter (Dust removal -Fabric filters, Electrostatic precipitators, Wet electrostatic precipitators).	1
Reduction technologies: unburned hydrocarbons, halogen, trace elements.	1
Discussion and written test.	1

Form of laboratory	hours
Introduction. Info on the rules to pass the classes. Principles of thermal analysis. Methods to investigate sorbent regeneration.	4
Thermograwimetric tests of sulphur dioxide removal using solid sorbents.	6
Use of TGA for testing adsorbents (sorption capacity).	4
Use of TGA for testing adsorbents for CO_2 capture (sorption capacity adsorption/desorption profiles, lifetime of the adsorbents using multiple adsorption and regeneration cycles, long-term tests to determine the chemical and physical stability of the sorbents.	4
CO_2 separation by adsorption method.	10
Reporting and discussion.	2

COURSE STUDY METHODS

1. Lectures using multimedia presentations
2. Laboratory: Analysis of methodological materials, experimental investigations, discussion and analysis of the results.

METHODS OF ASSESMENT (F - formative; S - summative)

F1. – assessment self-preparation for classes
F2. – assessment of student's activity during the classes
S1. – verification of student's knowledge (reports and discussion).

STUDENT WORKLOAD

Form of activity	Workload (hours)
Participation at lectures	**15 h**
Participation at classes	**- h**
Laboratory	**30 h**
Participation at project classes	**- h**
Participation at seminar	**- h**
Preparation course on e-learning	**- h**
Test	**2 h**
Entrance test for laboratory classes	**- h**
Project's defence	**- h**
Exam	**2 h**
Consultation hours	**11 h**
DIRECT TEACHING, hours/ ECTS	**60 h / 2ECTS**
Preparation for tutorials	**- h**
Preparation for laboratories	**15 h**
Preparation for projects	**- h**
Preparation for seminars	**- h**
Preparation for e-learning classes	**- h**
Participation in e-learning classes	**- h**
Working on project	**- h**
Preparation for tests	**5 h**
Preparation for exam	**- h**
SELF-STUDY, hours/ ECTS	**20 h / 1 ECTS**

TOTAL (hours)	**∑ 80 h**
TOTAL ECTS	**3 ECTS**

PRIMARY AND SUPPLEMENTARY TEXTBOOKS

Zhong Chao Tan, Air Pollution and Greenhouse Gases: From Basic Concepts to Engineering. Springer 2014
Cooper-Alley, Air Pollution Control: A Design Approach", Waveland Press, Fourth Edition, 2011.
Dullien F.A.L. Industrial gas cleaning, Acad. Press, 1989 – 285, Uniwersytet Michigan
Heinz-Peter Schmitz, Dictionary of Boiler, Firing System and Flue-gas Cleaning Technology (English and German Edition) (German) Hardcover, 2007.
Rafał Kobyłecki, Michał Wichliński, Grzegorz Wielgosz, Zbigniew Bis; EMISSION OF MERCURY FROM POLISH LARGE-SCALE UTILITY BOILERS; Journal of Ecological Engineering Volume 17, Issue 5, Nov. 2016, pages 128–131
Majchrzak-Kucęba I, Wawrzyńczak D., Ściubidło A., Zdeb J., Smółka W., Zajchowski A., Stability and regenerability of acivated carbon used for CO2 removal in pilot DR-VPSA unit in real power plant conditions, Journal of CO_2 Utilization 29, 1–11, 2019.
Majchrzak-Kucęba I, Wawrzyńczak D., Ściubidło A., s, Application of metal-organic frameworks in VPSA technology for CO_2 capture, Fuel, 255,1157-73, 2019.

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Learning outcome	In relation to the learning outcomes specified for the field of study	Course objectives	Course content	Course study methods	Methods of assesment
EU 1	**K_W01, K_W10, K_U05, K_U06, K_K01**	**C.1, C.2**	Lecture/ Laboratory	**1, 2**	**F1, F2, S1**
EU 2	**K_W01, K_W10, K_U05, K_U06, K_K01**	**C.1, C.2**	Lecture/ Laboratory	**1, 2**	**F1, F2, S1**

II. OTHER USEFUL INFORMATION

1. All the information on the class schedule is posted on the student information board and online at: www.is.pcz.pl
2. The information about the consultation hours is provided to students during the first meeting and posted online at the Department of Energy Engineering web page.
3. The information on the rules to complete the course is provided to students during the first meeting.

Course title: **Business and Innovation in Environmental Protection**		
Programme: **Intelligent Energy for Environmental Protection**		Code: **2.2**
Type of course: **Module 2**	Course level: **II**	Semester: **III**
Form of classes: **lecture, project**	Number of hours per week/meeting: **1L, 2P**	Credit points: **3**
Education profile: **general academic**		Course language: **English**
Enrolment: **no**		

SYLLABUS

I. COURSE CHART

COURSE OBJECTIVES

C.1. Familiarize students with the knowledge of business and innovation in environmental protection.
C.2. Understanding the principles of projects creating.
C.3. Familiarize students with the presentation of the project.

PRELIMINARY COURSE REQUIREMENTS FOR KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge in the fields of biology, ecology
2. Knowledge in the fields of environmental protection

LEARNING OUTCOMES

EU 1 - Student knows the principles of projects creating.
EU 2 - Student knows the principles of research results preparation.
EU 3 - Student has knowledge about the presentation of the project.

COURSE CONTENT

Form of classes – lectures	**Hours**
Introduction to the lectures.	1
Innovation in environmental protection.	3
How is scientific research funded?	4
Projects' proposals examples.	4
Scientific articles to read.	2
Final conclusion	1
Form of classes - project	**Hours**
Introduction.	2
Leadership. The basic rules for projects creating.	4
The most commonly used scientific research methods.	4
Features of research methods.	4

The method of analysis and critique of the literature.	4
Application of statistical methods in scientific research.	4
Scientific research conducting.	4
Preparation of the research results and their presentation.	4

COURSE STUDY METHODS

1. Lectures with the use of multimedia presentations.
2. Project with using multimedia presentations

METHODS OF ASSESMENT (F - formative; S - summative)

F1. – Evaluation of student's preparation for classes
S1. – Project realization

STUDENT WORKLOAD

Form of activity	Workload (hours)
Participation in lectures	**15 h**
Participation in classes	**-h**
Laboratory	**-h**
Participation in project classes	**30 h**
Participation in seminar	**-h**
Preparation course on e-learning	**-h**
Test	**-h**
Entrance test for laboratory classes	**-h**
Project's defence	**1**
Exam	**-h**
Consultation hours	**15 h**
DIRECT TEACHING, hours/ ECTS	**61 h / 2 ECTS**
Preparation for tutorials	**-h**
Preparation for laboratories	**-h**
Preparation for projects	**30 h**
Preparation for seminars	**-h**
Preparation for e-learning classes	**-h**
Participation in e-learning classes	**-h**
Working on project	**15 h**
Preparation for tests	**-h**
Preparation for exam	**-h**
SELF-STUDY, hours/ ECTS	**45 h / 1 ECTS**
TOTAL (hours)	**∑ 106 h**
TOTAL ECTS	**3 ECTS**

PRIMARY AND SUPPLEMENTARY TEXTBOOKS

Innovation and entreprenurship, available at http://www.untag-smd.ac.id/files/Perpustakaan_Digital_1/ENTREPRENEURSHIP%20Innovation%20and%20entrepreneurship.PDF
Brychan Thomas , Christopher Miller , Lyndon Murphy, Innovation and small business – volume 1, available at http://bookboon.com/en/innovation-and-small-business-volume-1-ebook
Websites:

Inwestycje w innowacje, http://www.inwestycjewinnowacje.pl/ Innovation ebook, http://www.innovationmain.com/eBook.html

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Learning outcome	In relation to the learning outcomes specified for the field of study	Course objectives	Course content	Course study methods	Methods of assesment
EU 1	**K_W02, K_W03, K_W04, K_U05, K_K01**	**C1**	Lecture/ project	**1**	**F1, S1**
EU 2	**K_W02, K_W03, K_W04, K_U05, K_K01**	**C2**	Lecture/ project	**1**	**F1, S1**
EU 3	**K_W02, K_W03, K_W04, K_U05, K_K01**	**C3**	Lecture/ project	**1,2**	**F1, S1**

II. OTHER USEFUL INFORMATION

1. All the information on the class schedule is posted on the student information board and online at: www.is.pcz.pl
2. The information about the consultation hours is provided to students on the first class meeting.
3. The information on course completion and grade is provided to students on the first class meeting.

Course title: **Computer Modelling of Environmental Processes**		
Programme**:** **Intelligent Energy for Environmental Protection**		Code: **2.3**
Type of course: **Module 2**	Course level: **II**	Semester: **I**
Form of classes: **Project**	Number of hours per week: **4P**	Credit points: **4**
Education profile**:** **general academic**		Course language: **English**
Enrolment**: no**		

SYLLABUS

I. COURSE CHART

COURSE OBJECTIVES

C.1. Providing students with knowledge on computer modeling rules and applications of modeling for solving engineering problems
C.2. Providing students with knowledge on engineering software capabilities, functionalities, limitations, etc.

PRELIMINARY COURSE REQUIREMENTS FOR KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge on mathematics, physics and fluid mechanics
2. Basic knowledge on performing engineering calculations
3. The ability to use literature

LEARNING OUTCOMES

EU 1 - Student knows rules of computer modeling and has ability to apply them to solving engineering problems
EU 2 - Student knows how engineering software works and is able to select appropriate software for solving desired problem
EU 3 - Student is able to properly asses results of computer modeling process

COURSE CONTENT

Form of classes - project	Hours
Introduction to computer modeling. Providing students with course concept and individual project data sets.	4
Introduction to MathCad software.	4
Calculations of cyclone geometry	12
Introduction to Ansys – Fluent	4
Preparation of cyclone geometry for fluid flow calculations	12
Generation of mesh and boundary conditions setup	4

Performing calculations	12
Analysis of results and report preparation	8

COURSE STUDY METHODS

1. Multimedia presentation
2. Conventional and interactive board
3. Technical engineering software

METHODS OF ASSESMENT (F - formative; S - summative)

F1. – The assessment of students preparation for classes
F2. – The assessment of individual students work during classes
S1. – The assessment of project report prepared by student

STUDENT WORKLOAD

Form of activity	Workload (hours)
Literature study	**30 h**
Preparation for classes	**15 h**
Preparation of the report	**10 h**
Participation in lectures	**- h**
Participation in classes	**- h**
Laboratory	**- h**
Participation in project classes	**60 h**
Participation in seminar	**- h**
Preparation course on e-learning	**- h**
Test	**- h**
Entrance test for laboratory classes	**- h**
Project's defence	**- h**
Exam	**- h**
Consultation hours	**15 h**
DIRECT TEACHING, hours/ ECTS	**75 h / 3 ECTS**
Preparation for tutorials	**- h**
Preparation for laboratories	**- h**
Preparation for projects	**15 h**
Preparation for seminars	**- h**
Preparation for e-learning classes	**- h**
Participation in e-learning classes	**- h**
Working on project	**15 h**
Preparation for tests	**- h**
Preparation for exam	**- h**
SELF-STUDY, hours/ ECTS	**30 h / 1 ECTS**
Total	**∑ 105 h**
Total ECTS	**4**

PRIMARY AND SUPPLEMENTARY TEXTBOOKS

Ángel A. Juan Pérez, Computer Modeling & Simulation, Universitat Oberta de Catalunya, http://openaccess.uoc.edu/webapps/o2/bitstream/10609/57344/1/Computer%20Modeling%20%26%20Simulation.pdf
Ronald W. Rousseau, Handbook of Separation Process Technology, John Wiley & Sons, 1987 New York
Wen-Ching Yang, Handbook of Fluidization and Fluid-Particle Systems, CRC Press, 2003 New York
V.E. Mizonov, S.G. Ushakov. Aerodynamic separation powders (Chemistry, Moscow, 1989)
R. Zarzycki, M. Panowski, Analysis of the flue gas preparation process for the purposes of carbon dioxide separation using the adsorption methods, Journal of Energy Resources Technology 140 (3), 2018, pp. 032008-1 - 032008-7
D Wawrzyńczak, M Panowski, I Majchrzak-Kucęba, Possibilities of CO2 purification coming from oxy-combustion for enhanced oil recovery and storage purposes by adsorption method on activated carbon, Energy 180, 2019, pp. 787-796
ANSYS Fluent documentation and help

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Learning outcome	In relation to the learning outcomes specified for the field of study	Course objectives	Course content	Course study methods	Methods of assesment
EU 1	**K_W12, K_U05, K_U06, K_K01**	**C.1, C.2**	Project	**1, 2, 3**	**F1, F2, S1**
EU 2	**K_W12, K_U05, K_U06, K_K01**	**C.1, C.2**	Project	**1, 2, 3**	**F1, F2, S1**
EU 3	**K_W12, K_U05, K_U06**	**C.1, C.2**	Project	**1, 2, 3**	**F1, F2, S1**

II. OTHER USEFUL INFORMATION

1. All the information on the class schedule is posted on the student information board and online at: www.is.pcz.pl
2. The information about the consultation hours is provided to students on the first class meeting and posted online at…
3. The information on course completion and grade is provided to students on the first class meeting.

Course title: **Renewable energy sources**		
Programme: **Intelligent energy for environmental protection**		Code: **2.4**
Type of course: **Module 2**	Course level: **II**	Semester: **I**
Form of classes: **lecture, tutorials**	Number of hours per week/meeting: **2L, 2T, E**	Credit points: **4 ECTS**
Education profile: **general academic**		Course language: **English**
Enrolment: **no**		

SYLLABUS

I. COURSE CHART

COURSE OBJECTIVES

C.1. Getting acquainted with technologies and ways to convert energy from renewable sources.

C.2. Knowledge on practical aspects of the application of RES-based technologies to produce electricity, heat and chill.

PRELIMINARY COURSE REQUIREMENTS FOR KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge on the fundamentals of physics and energy conversion.
2. Ability for independent study of the literature and technical papers.

LEARNING OUTCOMES

EU 1 - Knowledge on the fundamentals of energy conversion and renewable energy sources (RES)

EU 2 - Knowledge on the fundamentals of RES application.

COURSE CONTENT

Form of classes - lectures	hours
Introduction and energy conversion fundamentals. World energy resources. Policy and development trends.	2
Solar energy and conversion systems.	2
Solar panels, technologies and applications.	2
Photovoltaics and PV systems.	2
Hydropower.	2
Geothermal energy.	2
Wind energy, wind turbines and conversion technologies.	2
Biomass as energy source. Requirements for plant growth. Biomass drying and mechanical processing (cutting, pellets, briquets, ballots, etc.).	4
Thermal treatment of biomass. Combustion, gasification and pyrolysis. Fermentation of organic matter. Biogas, bioetanol and biodiesel.	4
Heat pumps and chillers.	2

Energy balance and conservation. Energy storage. Energy efficiency. Passive buildings.	4
Economical and legal aspects associated with RES. Perspectives and development trends. Sustainable development and circular economy.	1
Discussion and written test.	1
Form of classes - tutorials	**hours**
Introduction. Info on the rules to pass the classes. Discussion on energy conversion fundamentalss. Basic engineering calculations of energy conversion.	6
Engineering calculations and discussion of the results for some chosen energy conversion systems (solar, PV, hydro, geothermal).	6
Engineering calculations and discussion of the results for wind energy systems	2
Engineering calculations and discussion of the results for biomass energy systems	6
Engineering calculations and discussion of the results for heat pumps and chillers.	4
Engineering calculations: energy balance, energy efficiency, passive buildings.	4
Written test.	2

COURSE STUDY METHODS

1. Lectures using multimedia presentations
2. Tutoring: Analysis of methodological materials, calculation of some example cases, discussion and analysis of the results.

METHODS OF ASSESMENT (F - formative; S - summative)

F1. – assessment self-preparation for classes
F2. – assessment of student's activity during the classes
S1. – verification of student's knowledge (discussion and written test).

STUDENT WORKLOAD

Form of activity	Workload (hours)
Participation at lectures	**30 h**
Participation at classes	**30 h**
Laboratory	**- h**
Participation at project classes	**- h**
Participation at seminar	**- h**
Preparation course on e-learning	**- h**
Test	**2 h**
Entrance test for laboratory classes	**- h**
Project's defence	**- h**
Exam	**- h**
Consultation hours	**3 h**
DIRECT TEACHING, hours/ ECTS	**65 h / 2,6 ECTS**
Preparation for tutorials	**15 h**
Preparation for laboratories	**- h**
Preparation for projects	**- h**
Preparation for seminars	**- h**
Preparation for e-learning classes	**- h**
Participation in e-learning classes	**- h**

Working on project **Preparation for tests** **Preparation for exam**	**- h** **5 h** **15 h**
SELF-STUDY, hours/ ECTS	**35 h / 1,4 ECTS**
TOTAL (hours)	**∑ 100 h**
TOTAL ECTS	**4 ECTS**

PRIMARY AND SUPPLEMENTARY TEXTBOOKS

Robert Ferry, Elizabeth Monoian, **A Field Guide to Renewable Energy Technologies,** Society for Cultural Exchange, 2012.
B. Viswanathan, An Introduction to Energy Sources, **,** Indian Institute of Technology, 2006.
Books, newspapers and magazines available via internet, as well as those found in the Science Library, particularly: Energy, Energy Economics, Energy Policy, Resource and Energy Economics, Climate Policy, Bioresource Technology, Biomass & Bioenergy, Fuel Processing Technology, etc..
IEA and EPA publications, EU Directives and technical papers.

SUBJECT COORDINATOR (NAME, SURNAME, E-MAIL ADDRESS)

1. Rafał Kobyłecki, rafalk@is.pcz.pl

NAME OF LECTURER (s) (NAME, SURNAME, E-MAIL ADDRESS)

1. Rafał Kobyłecki, rafalk@is.pcz.pl

Learning outcome	In relation to the learning outcomes specified for the field of study	Course objectives	Course content	Course study methods	Methods of assesment
EU 1	**K_W05, K_U03, K_U04, K_U05, K_K01**	**C.1, C.2**	Lecture/ tutorials	**1, 2**	**F1, F2, S1**
EU 2	**K_W05, K_U03, K_U04, K_U05, K_K01**	**C.1, C.2**	Lecture/ tutorials	**1, 2**	**F1, F2, S1**

II. OTHER USEFUL INFORMATION

1. All the information on the class schedule is posted on the student information board and online at: www.is.pcz.pl
2. The information about the consultation hours is provided to students during the first meeting and posted online at the Faculty web page.
3. The information on the rules to complete the course is provided to students during the first meeting.

Course title: **Smart cities**		
Programme**:** **Intelligent Energy for Environmental Protection**		Code: **2.5**
Type of course: **Module 2**	Course level: **II**	Semester: **III**
Form of classes: **Lecture, project**	Number of hours per week: **2L, 1P**	Credit points: **3**
Education profile: **general academic**		Course language: **English**
Enrolment**: no**		

SYLLABUS

I. COURSE CHART

COURSE OBJECTIVES

C.1. Understanding smart community concepts and being able to analyze smart city cases is important for urban planners, managers and policymakers

C.2. Knowledge about modern concepts of urban infrastructure development in key areas: water distribution, waste management, transport system, IT technologies.

PRELIMINARY COURSE REQUIREMENTS FOR KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic information about urban infrastructure (water, transport, waste, IT)

LEARNING OUTCOMES

EU 1 - Understanding the general current economic, social and environmental trends that jeopardize sustainable growth of cities

EU 2 - Ability to investigate, analyze and explore "smart city" concepts and solutions in relation to the climate mitigation challenges for important urban development sectors, such as transportation, buildings, consumption, energy production, waste management, water management

COURSE CONTENT

Form of classes - lectures	Hours
Introduction to smart cities – philosophy and concepts	2
E-governance and citizen services	2
IT systems in smart cities	4
Waste management in smart cities	4
Green and smart buildings	4
Smart energy systems	4
Smart water and wastewater systems	4
Smart transport systems	4
Future challenges for smart cities	2

Form of classes - project	Hours
Introduction to smart cities	1
E-Governance and citizen services	2
Waste management in smart city	2
Water management in smart city	3
Energy management	3
Urban mobility	2
Discussion on projects prepared by students	2

COURSE STUDY METHODS

1.	Lectures using multimedia presentations
2.	Videos: short talks and case study videos

METHODS OF ASSESMENT (F - formative; S - summative)

F1. – weekly responses
F2. – classes participation
S1. – Final written paper

STUDENT WORKLOAD

Form of activity	Workload (hours)
Participation in lectures	**30 h**
Participation in classes	**- h**
Laboratory	**- h**
Participation in project classes	**15 h**
Participation in seminar	**- h**
Preparation course on e-learning	**- h**
Test	**2 h**
Entrance test for laboratory classes	**- h**
Project's defence	**- h**
Exam	**- h**
Consultation hours	**2 h**
DIRECT TEACHING, hours/ ECTS	**49 / 1,7 ECTS**
Preparation for tutorials	**- h**
Preparation for laboratories	**- h**
Preparation for projects	**10 h**
Preparation for seminars	**- h**
Preparation for e-learning classes	**- h**
Participation in e-learning classes	**- h**
Working on project	**25 h**
Preparation for tests	**5 h**
Preparation for exam	**- h**
SELF-STUDY, hours/ ECTS	**40 h / 1,3 ECTS**
TOTAL (hours)	**∑ 89 h**
TOTAL ECTS	**3 ECTS**

PRIMARY AND SUPPLEMENTARY TEXTBOOKS

Graham W., (2016), Dream Cities: Seven Urban Ideas That Shape the World, Harper Publishing House
Tresca S., (2015), Future Cities: 42 Insights and Interviews with Influencers, Startups, Investors
Richard T. (2014), Urban Ecology: Science of Cities,
Townsend A., (2014), Smart Cities: Big Data, Civic Hackers, and the Quest for a New Utopia

SUBJECT COORDINATOR (NAME, SURNAME, E-MAIL ADDRESS)

1. Maciej Mrowiec, mrowiecm@is.pcz.czest.pl

NAME OF LECTURER (s) (NAME, SURNAME, E-MAIL ADDRESS)

1. Maciej Mrowiec, mrowiecm@is.pcz.czest.pl

Learning outcome	In relation to the learning outcomes specified for the field of study	Course objectives	Course content	Course study methods	Methods of assesment
EU 1	**K_W04, K_W07, K_W09, K_U05**	**C1**	Lecture	**1**	**F1, F2**
EU 2	**K_U05, K_U06, K_U09, K_K02**	**C2**	Projekct	**1, 2**	**F2, S1**

II. OTHER USEFUL INFORMATION

1. All the information on the class schedule is posted on the student information board and online at: www.is.pcz.pl
2. The information about the consultation hours is provided to students on the first class meeting and posted online at …
3. The information on course completion and grade is provided to students on the first class meeting.

Course title: **Biochar for Advanced Polygeneration**		
Programme: **Intelligent energy for environmental protection**		Code: **3.1**
Type of course: **Module 3**	Course level: **II**	Semester: **III**
Form of classes: **lecture, laboratory**	Number of hours per week/meeting: **2L, 2Lab**	Credit points: **4**
Education profile: **general academic**		Course language: **English**
Enrolment: **no**		

SYLLABUS

I. COURSE CHART

COURSE OBJECTIVES

C.1. Getting acquainted with technologies of thermal treatment of solid fuels for advanced technologies.
C.2. Knowledge on practical and environmental aspects of the application of biochar.

PRELIMINARY COURSE REQUIREMENTS FOR KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge on the fundamentals of chemistry, combustion and heat transfer.
2. Ability for independent study of the literature and technical papers.

LEARNING OUTCOMES

EU 1 - Knowledge on the fundamentals of thermolysis of solid substances.
EU 2 - Knowledge on biochar properties and applications.

COURSE CONTENT

Form of classes - lectures	hours
Environmental aspects of human activity. Energy resources. Sustainable development and circular economy. Climat changes and current policy.	4
Biomass production, properties and possible use.	2
Pyrolysis. Parameters, technologies and products.	4
Biochar production and properties.	2
Energy conversion possibilities. Polygeneration - idea and system features.	4
Some chosen application of the biochar for classical and advanced applications.	4
Energy – environment – agriculture: symbiosis for sustainable development.	2
Reduction of the emission of pollutants and nutrient leaching by the application of the biochar.	2
Water resources and conservation. Water preparation for anthropogenic activity.	2
Economical and legal aspects associated with biochar production and application. CO_2 emisssion avoided.	2
Discussion and written test.	2

Form of classes - laboratory	hours
Introduction. Info on the rules to pass the classes. Methods to investigate fuel parameters.	2
Investigation and calculation of biomass parameters and properties. Wood charring and analysis of product properties.	4
Investigation of biomass processing and biochar production. Effect of temperature, particle size and residence time on biochar yield and properties.	6
Investigation of biochar porosity, structure and morphology – some chosen cases.	6
Investigation of biochar parameters on nutrient leaching, water retention and pollutant capture – some chosen cases.	6
Biochar particle size. Attrition and ignition.	4
Reporting and discusssion.	2

COURSE STUDY METHODS

1. Lectures using multimedia presentations
2. Laboratory: Analysis of methodological materials, experimental investigations, discussion and analysis of the results.

METHODS OF ASSESMENT (F - formative; S - summative)

F1. – assessment self-preparation for classes
F2. – assessment of student's activity during the classes
S1. – verification of student's knowledge (reports and discussion).

STUDENT WORKLOAD

Form of activity	Workload (hours)
Participation at lectures	**30 h**
Participation at classes	**- h**
Laboratory	**30 h**
Participation at project classes	**- h**
Participation at seminar	**- h**
Preparation course on e-learning	**- h**
Test	**2 h**
Entrance test for laboratory classes	**- h**
Project's defence	**- h**
Exam	**- h**
Consultation hours	**3 h**
DIRECT TEACHING, hours/ ECTS	**65 h / 3 ECTS**
Preparation for tutorials	**- h**
Preparation for laboratories	**15 h**
Preparation for projects	**- h**
Preparation for seminars	**- h**
Preparation for e-learning classes	**- h**
Participation in e-learning classes	**- h**
Working on project	**- h**
Preparation for tests	**5 h**
Preparation for exam	**- h**

SELF-STUDY, hours/ ECTS	**20 h / 1 ECTS**
TOTAL (hours)	**∑ 85 h**
TOTAL ECTS	**4 ECTS**

PRIMARY AND SUPPLEMENTARY TEXTBOOKS

Lehmann J. and Joseph S., Biochar for Environmental Management, Earthscan, 2009.
Taylor P., McLaughlin H., The Biochar Revolution: Transforming Agriculture & Environment, 2010.
Singh B., Camps-Arbestain M., Lehmann J., Biochar: A Guide to Analytical Methods, Csiro Publishing, 2017.
Books, newspapers and magazines available via internet, as well as those found in the Science Library, particularly: Bioresource Technology, Biomass & Bioenergy, Climate Policy, etc..

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NAME OF LECTURER (s) (NAME, SURNAME, E-MAIL ADDRESS)

1. Rafał Kobyłecki, rafalk@is.pcz.pl

Learning outcome	In relation to the learning outcomes specified for the field of study	Course objectives	Course content	Course study methods	Methods of assesment
EU 1	**K_W08, K_U03, K_U04, K_U05, K_K01**	**C.1, C.2**	Lecture/ laboratory	**1, 2**	**F1, F2, S1**
EU 2	**K_W08, K_U03, K_U04, K_U05, K_K01**	**C.1, C.2**	Lecture/ laboratory	**1, 2**	**F1, F2, S1**

II. OTHER USEFUL INFORMATION

1. All the information on the class schedule is posted on the student information board and online at: www.is.pcz.pl
2. The information about the consultation hours is provided to students during the first meeting and posted online at the Faculty web page.
3. The information on the rules to complete the course is provided to students during the first meeting.

Course title: **Carbon Management in the Environmental Processes**		
Programme: **Intelligent Energy for Environmental Protection**		Code: **3.2**
Type of course: **Module 3**	Course level: **II**	Semester: **II**
Form of classes: **Lecture, project**	Number of hours per week/meeting: **2L, 2P**	Credit points: **4**
Education profile: **generally academic**		Course language: **English**
Enrolment: **no**		

SYLLABUS

I. COURSE CHART

COURSE OBJECTIVES

C.1. Providing basic knowledge about basic climate change and its interaction with greenhouse gas fluxes in managed and natural ecosystems around the world
C.2. Providing of basic knowledge of changing land use and mitigation future climate change
C.3. Providing basic knowledge about emissions of the greenhouse gases, emissions from agriculture, then carbon fluxes in forests

PRELIMINARY COURSE REQUIREMENTS FOR KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge from chemistry
2. Knowledge from biology of living organisms
3. Basic knowledge from environmental protection and management

LEARNING OUTCOMES

EU 1 - Student knows the basic climate change and its interaction with greenhouse gas fluxes in managed and natural ecosystems around the world
EU 2 - knows how changing land use can either exacerbate or mitigate future climate change,
EU 3 - knows how land use can be made more resilient to the future impacts of climate change
EU 4 - investigates emissions of the greenhouse gases, emissions from agriculture, then carbon fluxes in forests.

COURSE CONTENT

Form of classes - lectures	Hours
Emissions baseline & projections; Measurement , Recent trends emissions	4
Variation of carbon emissions	4
Effect of research activity on heating load	4
Recent initiatives for reducing caron emissions	4
Carbon management plan	4
Responsibility for carbon management; Carbon management framework,	4
Carbon reduction targets	4
Knowledge test	2

Form of classes - tutorials	Hours
Carbon Management in the Environmental Processes - introduction	2
Case study based on bibliographic data: - Carbon footprint analysis as a tool for energy and environmental management in small and medium-sized enterprises - Making Advances in Carbon Management Best practice from the Carbon Information Leaders - Towards a universal carbon footprint standard: A case study of carbon management in academia	18
Presentation from the three topics	8
Final test	2

COURSE STUDY METHODS

1. blackboard, interactive whiteboard
2. multimedia presentation
3. literature from on-line bibliographic databases

METHODS OF ASSESMENT (F - formative; S - summative)

F1. – activity in classes
S1. – test from the lectures
S2. – test and presentation from the tutorials
S3. - evaluation of the tutorials reports performance including analysis and verification of the obtained results

STUDENT WORKLOAD

Form of activity	Workload (hours)
Participation in lectures	**28 h**
Participation in classes	**- h**
Laboratory	**- h**
Participation in project classes	**28 h**
Participation in seminar	**- h**
Preparation course on e-learning	**- h**
Test	**4 h**
Entrance test for laboratory classes	**- h**
Project's defence	**- h**
Exam	**- h**
Consultation hours	**5 h**
DIRECT TEACHING, hours/ ECTS	**65 h / 3 ECTS**
Preparation for tutorials	**- h**
Preparation for laboratories	**- h**
Preparation for projects	**15 h**
Preparation for seminars	**- h**
Preparation for e-learning classes	**- h**
Participation in e-learning classes	**- h**
Working on project	**- h**

Preparation for tests **Preparation for exam**	**15 h** **- h**
SELF-STUDY, hours/ ECTS	**30 h / 1 ECTS**
TOTAL (hours)	**∑ 95 h**
TOTAL ECTS	**4 ECTS**

PRIMARY AND SUPPLEMENTARY TEXTBOOKS

Matthew John Franchetti, Defne Apul , Carbon Footprint Analysis: Concepts, Methods, Implementation, and Case Studies, 1st Edition, CRC Press , Published June 18, 2012
Rohinton Emmanuel, Keith Baker, Carbon Management in the Built Environment, 1st Edition, Routledge Published June 7, 2012
Carbon Management, type of journal (quarterly)

SUBJECT COORDINATOR (NAME, SURNAME, E-MAIL ADDRESS)

1. Anna Grobelak, agrobelak@is.pcz.czest.pl

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1. Anna Grobelak, agrobelak@is.pcz.czest.pl

Learning outcome	In relation to the learning outcomes specified for the field of study	Course objectives	Course content	Course study methods	Methods of assesment
EU 1	**K_W02, K_W06, K_W10, K_U03, K_U04, K_U05, K_K02**	**C.1-2**	lecture/ project	**1-2**	**S1**
EU 2	**K_W02, K_W06, K_W10, K_U03, K_U04, K_U05, K_K02**	**C.1-2**	lecture/ project	**1-2**	**S1**
EU 3	**K_W02, K_W06, K_W10, K_U03, K_U04, K_U05, K_K02**	**C.3**	project	**3**	**F1, S2-3**
EU 4	**K_W02, K_W06, K_W10, K_U03, K_U04, K_U05, K_K02**	**C.3**	project	**3**	**F1, S2-3**

II. OTHER USEFUL INFORMATION

1. All the information on the class schedule is posted on the student information board and online at: www.is.pcz.pl
2. The information about the consultation hours is provided to students on the first class meeting and posted online at …
3. The information on course completion and grade is provided to students on the first class meeting.

Course title: **Energy Conversion Technologies**		
Programme: **Intelligent energy for environmental protection**		Code: **3.3**
Type of course: **Module 3**	Course level: **II**	Semester: **II**
Form of classes: **lecture, tutorials**	Number of hours per week/meeting: **2L, 2T, E**	Credit points: **4**
Education profile: **general academic**		Course language: **English**
Enrolment: **no**		

SYLLABUS

I. COURSE CHART

COURSE OBJECTIVES

C.1. Getting acquainted with fundamentals of energy conversion technologies.
C.2. Knowledge on practical aspects of modern and efficient energy conversion.

PRELIMINARY COURSE REQUIREMENTS FOR KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge on the fundamentals of physics, chemistry and thermodynamics.
2. Ability for independent study of the literature and technical papers.

LEARNING OUTCOMES

EU 1 - Knowledge on the fundamentals of various technologies of energy conversion.
EU 2 - Knowledge on practical aspects of power, heat and chill generation.

COURSE CONTENT

Form of classes - lectures	**hours**
Energy sources and fundamentals of energy conversion. Laws of thermodynamics.	4
Phase changes. p-v, i-v, i-s, T-s, i-X diagrams and their applications.	4
Carnot cycle. Heat pump cycle. Power generation cycles.	2
Main elements of the power generation system. System design criteria.	3
Cycle efficiency. Increase of the cycle efficiency and availability.	2
Heat transfer. Balance calculations.	3
Hybrid and advanced systems for energy conversion.	4
Energy storage.	2
Energy conversion byproducts and pollutants. Environmental aspects. Circular economy and sustainable development.	4
Discussion and written test.	2
Form of classes - tutorials	**hours**
Introduction. Info on the rules to pass the classes. Basic engineering calculations (thermodynamics, fluid flow, mass and energy balances).	4

Thermodynamic calculations of energy conversion systems.	4
Balance and engineering calculations (efficiency, emisssion, etc.).	4
Engineering calculations based on the data from i-s, p-i, T-s, i-X diagrams.	4
Cycle efficiency and efficiency increase – engineering calculations. Calculation of the system availability.	2
Heat transfer – engineering calculations.	5
Pollutant emission and environmental issues – some fundamental engineering calculations.	5
Written test.	2

COURSE STUDY METHODS

1. Lectures using multimedia presentations
2. Tutoring: Analysis of methodological materials, calculation of some example cases, discussion of the results.

METHODS OF ASSESMENT (F - formative; S - summative)

F1. – assessment self-preparation for classes
F2. – assessment of student's activity during the classes
S1. – verification of student's knowledge (discussion and written test).

STUDENT WORKLOAD

Form of activity	Workload (hours)
Participation at lectures	**30 h**
Participation at classes	**30 h**
Laboratory	**- h**
Participation at project classes	**- h**
Participation at seminar	**- h**
Preparation course on e-learning	**- h**
Test	**4 h**
Entrance test for laboratory classes	**- h**
Project's defence	**- h**
Exam	**- h**
Consultation hours	**4 h**
DIRECT TEACHING, hours/ ECTS	**68 h / 2,6 ECTS**
Preparation for tutorials	**15 h**
Preparation for laboratories	**- h**
Preparation for projects	**- h**
Preparation for seminars	**- h**
Preparation for e-learning classes	**- h**
Participation in e-learning classes	**- h**
Working on project	**- h**
Preparation for tests	**5 h**
Preparation for exam	**15 h**
SELF-STUDY, hours/ ECTS	**35 h / 1,4 ECTS**
TOTAL (hours)	**∑ 103 h**
TOTAL ECTS	**4 ECTS**

PRIMARY AND SUPPLEMENTARY TEXTBOOKS

M. Rasul (ed.), Thermal power plants: advanced applications, InTech**,** 2013
K. Weston, Energy Conversion, PWS**,** 1992
G. Petrecca, Energy Conversion and Management. Principles and Applications, 2014.
Books, newspapers and magazines available via internet, as well as those found in the Science Library, particularly: Energy, Bioresource Technology, Biomass & Bioenergy, Fuel Processing Technology, etc..
IEA and EPA publications, EU Directives and technical papers.

SUBJECT COORDINATOR (NAME, SURNAME, E-MAIL ADDRESS)

1. Rafał Kobyłecki, rafalk@is.pcz.pl

NAME OF LECTURER (s) (NAME, SURNAME, E-MAIL ADDRESS)

1. Rafał Kobyłecki, rafalk@is.pcz.pl

Learning outcome	In relation to the learning outcomes specified for the field of study	Course objectives	Course content	Course study methods	Methods of assesment
EU 1	**K_W05, K_W06, K_U03, K_U04, K_U05, K_K01**	**C.1, C.2**	lecture tutorials	**1, 2**	**F1, F2, S1**
EU 2	**K_W05, K_W06, K_U03, K_U04, K_U05, K_K01**	**C.1, C.2**	lecture tutorials	**1, 2**	**F1, F2, S1**

II. OTHER USEFUL INFORMATION

1. All the information on the class schedule is posted on the student information board and online at: www.is.pcz.pl
2. The information about the consultation hours is provided to students during the first meeting and posted online at the Faculty web page.
3. The information on the rules to complete the course is provided to students during the first meeting.

Course title: **Intelligent Heating, Ventilation and Air Conditioning**		
Programme: **Intelligent Energy for Environmental Protection**		Code: **3.4**
Type of course: **Module 3**	Course level: **II level**	Semester: **I**
Form of classes: **lecture, project**	Number of hours per week/meeting: **2L, 2P, E**	Credit points: **4**
Education profile: **general academic**		Course language: **English**
Enrolment: **no**		

SYLLABUS

I. COURSE CHART

COURSE OBJECTIVES

C.1. Transfer of knowledge about thermal-physiological, hygienic and meteorological-climatic bases in the range of HVAC.
C.2. Transfer of knowledge about engineering solutions of HVAC systems and their components.
C.3. Defining energy balances for heating, ventilation and air-conditioning needs of systems.

PRELIMINARY COURSE REQUIREMENTS FOR KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge in the range of mathematics, physics, fluid mechanics, technical thermodynamics, building and the technical drawing.
2. Ability of solving problems in the environmental engineering with using of mathematical methods.
3. Ability to independently use of literature.

LEARNING OUTCOMES

EU 1 - student has knowledge about conditions of thermal comfort in the building,
EU 2 - student has knowledge of theoretical foundations and methods of practical operation in the field of construction and operation of heating and cooling equipment used in power engineering, heat engineering, ventilation and air conditioning,
EU 3 - student has the ability to design renewable and conventional energy sources in building and installation systems.

COURSE CONTENT

Form of classes - lectures	Hours
Basic information of hygiene associated with HVAC.	2
Meteorological-climatic basic concepts for HVAC systems.	2
Design thermal load of building.	2
Seasonal heat demand for heating.	2
Heat balance for purpose of determining stream of ventilation air.	2
Design cooling load of building.	2

Seasonal cooling demand for air conditioning.	2
Demand of thermal power and heat for domestic hot water systems.	2
Heating systems.	2
Heating systems components.	4
Basics of air treatment technique.	2
Ventilation and air conditioning systems.	2
Domestic hot water system and its components.	2
Final test.	2
Form of classes - project	**Hours**
Project of a heating system.	28
Verification, defense by students and evaluation of projects.	2

COURSE STUDY METHODS

1. Auditorium lectures using multimedia presentations
2. Calculation tutorials
3. Project tutorials

METHODS OF ASSESMENT (F - formative; S - summative)

F1. - evaluation of the level of assimilation of lectures and preparation for classes
F2. - evaluation of work in analyzing and solving problems
S1. - test of knowledge in the form of a colloquium and calculational problems
S2. – evaluation of projects

STUDENT WORKLOAD

Form of activity	**Workload (hours)**
Participation in lectures	**30 h**
Participation in classes	**- h**
Laboratory	**- h**
Participation in project classes	**30 h**
Participation in seminar	**- h**
Preparation course on e-learning	**- h**
Test	**2 h**
Entrance test for laboratory classes	**- h**
Project's defence	**2 h**
Exam	**2 h**
Consultation hours	**2 h**
DIRECT TEACHING, hours/ ECTS	**68 h / 2,2 ECTS**
Preparation for tutorials	**- h**
Preparation for laboratories	**- h**
Preparation for projects	**15 h**
Preparation for seminars	**- h**
Preparation for e-learning classes	**- h**
Participation in e-learning classes	**- h**
Working on project	**15 h**
Preparation for tests	**10 h**
Preparation for exam	**12 h**

SELF-STUDY, hours/ ECTS	**52 h / 2,8 ECTS**
TOTAL (hours)	**∑ 120 h**
TOTAL ECTS	**4 ECTS**

PRIMARY AND SUPPLEMENTARY TEXTBOOKS

Koczyk H.: Ogrzewnictwo praktyczne. Wydanie II, Wydawnictwo Systherm Serwis, Poznań, 2009
Nantka. M.: Ogrzewnictwo i Ciepłownictwo. Tom I, Wydanie II, Wydawnictwo Politechniki Śląskiej, Gliwice, 2010
Nantka. M.: Ogrzewnictwo i Ciepłownictwo. Tom II, Wydanie II, Wydawnictwo Politechniki Śląskiej, Gliwice, 2010
Pełech A.: Wentylacja i Klimatyzacja. Wydawnictwa Politechniki Wrocławskiej, Wydanie II, 2009
Recknagel H., Sprenger R. i inni: Ogrzewnictwo, Klimatyzacja, Ciepła woda, Chłodnictwo. Wydawnictwo OMNI SCALA – TECNOCLIMA, 2008
Sugarman S. C.: "HVAC fundamentals". The Fairmont Press, Inc., 2004
Gupton W.: "HVAC controls: operation & maintenance". Marcel Dekker, 2001
Bearg D.W.: "Indoor air quality and HVAC systems". CRC Press, 1993
Monger S.: "Testing and balancing HVAC air and water systems". The Fairmont Press, Inc., 2000
Levenhagen J. I.: "HVAC control system design diagrams". McGraw-Hill Professional, 1998
Turski M., Nogaj K., Sekret R. "The use of a PCM heat accumulator to improve the efficiency of the district heating substation" Energy 187 (2019) pp. 1–13 (115885) DOI: 10.1016/j.energy.2019.115885
Turski M., Sekret R. "Buildings and a district heating network as thermal energy storages in the district heating system" Energy & Buildings 179 (2018) pp. 49–56 DOI: 10.1016/j.enbuild.2018.09.015

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NAME OF LECTURER (s) (NAME, SURNAME, E-MAIL ADDRESS)

1. Michał Turski, m.turski@is.pcz.pl

Learning outcome	In relation to the learning outcomes specified for the field of study	Course objectives	Course content	Course study methods	Methods of assesment
EU 1	**K_W07, K_U05, K_U07, K_K01**	**C1**	Lecture/ project	**1**	**F1, S1**
EU 2	**K_W07, K_U05, K_U07, K_K01**	**C3**	Lecture/ project	**2**	**F1, S1**
EU 3	**K_U05, K_U07, K_U08, K_K01**	**C2**	Lecture/ project	**3**	**F2,S2**

II. OTHER USEFUL INFORMATION

1. All the information on the class schedule is posted on the student information board and online at: www.is.pcz.pl
2. The information about the consultation hours is provided to students on the first class meeting and posted online at …
3. The information on course completion and grade is provided to students on the first class meeting.

Course title: **Instrumental Methods in Environment**		
Programme**:** **Intelligent Energy for Environmental Protection**		Code: **3.5**
Type of course: **Module 3**	Course level: **II**	Semester: **I**
Form of classes: **lecture, laboratory**	Number of hours per week/meeting: **2L, 2LAB**	Credit points: **4**
Education profile: **general academic**		Course language: **English**
Enrolment**: no**		

SYLLABUS

I. COURSE CHART

COURSE OBJECTIVES

C.1. knowledge transfer of the basics of instrumental analysis and apparatus used in the analytical laboratory
C.2. preparation for work with apparatus for determination of constituents of water, sewage, soil and waste
C.3. skills in the perform determinations of the examined chemical parameters

PRELIMINARY COURSE REQUIREMENTS FOR KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. knowledge of mathematics, unit processes in the environmental engineering
2. skills of literature sources using
3. skills of logic thinking
4. manual skills during laboratory classes

LEARNING OUTCOMES

EU 1 - Has knowledge of the basics of instrumental analysis and apparatus used in the analytical laboratory
EU 2 - Has the ability to select the right instrumental analytical techniques and the use of instrumental equipment
EU 3 - Can prepare samples for determinations using instrumental methods
EU 4 - Is able to develop results and draw conclusions from laboratory experiments

COURSE CONTENT

Form of classes - lectures	Hours
Introduction to instrumental methods in environment	4
Spectroscopic methods of analysis: emission spectroscopy absorption spectroscopy (atomic absorption, UV-Visible) atomic absorption flame chemistry	4
Spectroscopic methods of analysis: fluorescence, phosphorescence and chemiluminescence spectroscopy	4

Spectroscopic methods of analysis: X-ray spectroscopy methods (absorption, diffraction, fluorescence) vibrational spectroscopy (FT-IR, Raman)	2
Other instrumental analysis methods: atomic and molecular mass spectrometry	2
Other instrumental analysis methods: electrochemical analysis (polarography, pulse polarographic methods, anodic stripping voltammetry) thermal methods (thermogravimetric and differential thermal analysis)	2
Other instrumental analysis methods: stripping voltammetry) thermal methods (thermogravimetric and differential thermal analysis)	2
Chromatography theory liquid chromatography modes and mechanisms: ion-exchange, adsorption, partition and permeation modes as practiced in high-pressure liquid chromatography, open column, thin layer and paper chromatography	4
Gas chromatography theory, instrumentation and operation supercritical fluid and capillary methods	6
Form of classes - laboratory	**Hours**
Introductory classes for laboratory classes	4
Errors in chemical analysis and methods of their evaluation Iron determination by spectrophotometric method - comparison to the standard	2
Determination of the oxygen content dissolved by the Winkler method	2
Determination of chlorides and oxidation by titration	2
Determination of mineral nitrogen by spectrophotometric methods	2
Determination of COD with the bichromate method and BZT5 with the respirometric method	2
Composting: pile design	2
Determination of sulfates by nephelometric method	2
Determination of total organic carbon in OWO	2
Determination of biogas composition on a gas chromatograph	2
Determination of PAHs and / or PCBs on a gas chromatograph coupled with a mass detector	2
Determination of heavy metal ions by atomic absorption spectrometry (ASA)	2
Determination of organic nitrogen in mineralized samples	2
Final test	2

COURSE STUDY METHODS

1. Lecture with multimedial presentations
2. Laboratory sets and devices

METHODS OF ASSESMENT (F - formative; S - summative)

F1. – assessment of individual preparation to classes
F2. – assessment of working in the group
S1. – credit test
S2. – assessment of laboratory exercises

STUDENT WORKLOAD

Form of activity	Workload (hours)
Participation in lectures	**30 h**
Participation in classes	**- h**
Laboratory	**30 h**
Participation in project classes	**- h**
Participation in seminar	**- h**
Preparation course on e-learning	**- h**
Test	**- h**
Entrance test for laboratory classes	**3 h**
Project's defence	**- h**
Exam	**- h**
Consultation hours	**12 h**
DIRECT TEACHING, hours/ ECTS	**75 h / 2,5 ECTS**
Preparation for tutorials	**20 h**
Preparation for laboratories	**25 h**
Preparation for projects	**- h**
Preparation for seminars	**- h**
Preparation for e-learning classes	**- h**
Participation in e-learning classes	**- h**
Working on project	**- h**
Preparation for tests	**- h**
Preparation for exam	**- h**
SELF-STUDY, hours/ ECTS	**45 h / 1,5 ECTS**
TOTAL (hours)	**∑ 120 h**
TOTAL ECTS	**4 ECTS**

PRIMARY AND SUPPLEMENTARY TEXTBOOKS

Sawyer D. T.; Chemistry experiments for instrumentals methods; IWA Publishing 2007.
Skoog D.A., Principles of Instrumental Analysis; Cengage Learning; 6 edition 2006.
Barbooti M. (Editor); Environmental Applications of Instrumental Chemical Analysis ; Apple Academic Press; 1 edition 2015.
Chatwal G. R., Anand S.K., Instrumental Methods Of Chemical Analysis, Himalaya Publishing House, 2018.
Andrade-Garda J.M., Carlosena-Zubieta A., Gómez-Carracedo M.P., Maestro-Saavedra M.A., Prieto-Blanco M.C., Soto-Ferreiro R.M., Problems of Instrumental Analytical Chemistry; Word Scientifics, 2017.
Rakocz K., Rosińska A., Changes in selected quality parameters during the treatment and distribution of water, Desalination and Water Treatment, 57 (3), 971-981, 2016.
Rosińska A., Dąbrowska L., Enhancement of coagulation process with powdered activated carbon in PCB and heavy metal ions removal from drinking water, Desalination and Water Treatment, 57, Issue 54, 26336-26344, 2016.

SUBJECT COORDINATOR (NAME, SURNAME, E-MAIL ADDRESS)

1. Agata Rosińska, rosinska@is.pcz.czest.pl

NAME OF LECTURER (s) (NAME, SURNAME, E-MAIL ADDRESS)

1. Beata Karwowska, beata.karwowska@pcz.pl

Learning outcome	In relation to the learning outcomes specified for the field of study	Course objectives	Course content	Course study methods	Methods of assesment
EU 1	**K_W01, K_W07**	**C.1**	Lecture	**1**	**S1**
EU 2	**K_W01, K_W07**	**C.1**	Lecture	**1**	**S1, F1, F2**
EU 3	**K_U01, K_U05, K_K01**	**C.2**	Laboratory	**2**	**S2, F2**
EU 4	**K_U01, K_U05, K_K01**	**C.2**	Laboratory	**2**	**S2, F2**

II. OTHER USEFUL INFORMATION

1. All the information on the class schedule is posted on the student information board and online at: www.is.pcz.pl
2. The information about the consultation hours is provided to students on the first class meeting and posted online at…
3. The information on course completion and grade is provided to students on the first class meeting.

Course title: **Intelligent technologies in environmental engineering**		
Programme: **Intelligent energy for environmental protection**		Code: **4.1**
Type of course: **Module 4, elective, block IA**	Course level: **II**	Semester: **I**
Form of classes: **Lecture, tutorial**	Number of hours per week/meeting: **2L, 2T**	Creditpoints: **4**
Education profile: **general academic**		Course language: **English**
Enrolment: **yes**		

SYLLABUS

I. COURSE CHART

COURSE OBJECTIVES

C.1. To relay to students knowledge on intelligent technologies and processes in environmental protection
C.2. To learn skills on processes necessary for designing technology of environmental treatment
C.3. To develop competence in understanding issues of technological and processes of environmental protection

PRELIMINARY COURSE REQUIREMENTS FOR KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. The students are expected to have background knowledge in the fields of environmental protection at level of I-st degree cycle
2. Students are expected to have basic competences in engineering calculations
3. They are also expected to have ability to work in a team

LEARNING OUTCOMES

EU 1 - has a knowledge in methods of treatment of wastewater, soil and sediments, can critically evaluate technological processes
EU 2 - is able to point out and evaluate the proper methods for removal of organic and inorganic contaminants from wastewater
EU 3 - is able to indicate and compare novel treatments for polluted sediments and soil

COURSE CONTENT

Form of classes - lectures	Hours
Hazard from the presence of inorganic and organic contaminants in selected environmental elements	4
Intelligent processes applied in the treatment of wastewater	6
The removal of organic and biogenic pollutants from wastewater	4
Innovative methods of sludge treatment	4
Novel treatments of polluted sediments	6

New methods of soil treatment	4
Colloquium	2
Form of classes - tutorials	**Hours**
Examples of innovative environmental technologies	12
Group discussion on a selected topic	8
Presentation on a selected topic	8
Course summary	2

COURSE STUDY METHODS

1. lectures with the use of multimedia presentation
2. tutorials

METHODS OF ASSESMENT (F - formative; S - summative)

F1 – performance during the tutorials
F2 –evaluation of laboratory work and preparation of laboratory report
P1 – colloquium

STUDENT WORKLOAD

Form of activity	**Workload (hours)**
Participation in lectures	**30 h**
Participation in classes	**30 h**
Laboratory	**- h**
Participation in project classes	**- h**
Participation in seminar	**- h**
Preparation course on e-learning	**- h**
Test	**- h**
Entrance test for laboratory classes	**2 h**
Project's defence	**- h**
Exam	**- h**
Consultation hours	**13 h**
DIRECT TEACHING, hours/ ECTS	**75 h / 2,5 ECTS**
Preparation for tutorials	**20 h**
Preparation for laboratories	**25 h**
Preparation for projects	**- h**
Preparation for seminars	**- h**
Preparation for e-learning classes	**- h**
Participation in e-learning classes	**- h**
Working on project	**- h**
Preparation for tests	**- h**
Preparation for exam	**- h**
SELF-STUDY, hours/ ECTS	**45 h / 1,5 ECTS**
TOTAL (hours)	**∑ 120 h**
TOTAL ECTS	**4 ECTS**

PRIMARY AND SUPPLEMENTARY TEXTBOOKS

Tchobanoglous G., Burton F., Stensel H.D. Wastewater Engineering Treatment and Reuse
Ochrona Środowiska, GUS, Warszawa 2018
Miksch K., Sikora J. (red.): Biotechnologia ścieków, Wydawnictwo Naukowe PWN, Warszawa 2010
Popenda A, Włodarczyk-Makuła M., Hazard from sediments contaminated with persistent organic pollutants (POPs), *Desalination and Water Treatment, 2018, vol.* 117 318–328 20
Popenda A., M. Włodarczyk-Makuła The application of biosurfactants into removal of selected micropollutants from soils and sediments, Desalination and Water Treatment, Volume 57, Issue 3, 2016, 1255-1261.D**OI:**10.1080/19443994.2014.996007
Popenda A, Włodarczyk-Makuła M., Sediments contamination with organic micropollutants: current state and perspectives, Civil and Environmental Engineering Reports CEER 2016; 21 (2): 089-107 DOI: 10.1515/ceer-2016-0025
Włodarczyk-Makuła M., Wiśniowska E., Popenda A., Monitoring of Organic Micropollutants in Effluents as Crucial Tool in Sustainable Development Monitoring mikrozanieczyszczeń organicznych jako ważne narzędzie realizacji zrównoważonego rozwoju– *Problems of Sustainable Development* 2018, vol. 13, no 2, 191-198
Janosz-Rajczyk M. (red.): Badania wybranych procesów oczyszczania ścieków, Wydawnictwo Politechniki Częstochowskiej, Częstochowa 2008

SUBJECT COORDINATOR (NAME, SURNAME, E-MAIL ADDRESS)

1. Agnieszka Popenda, apopenda@is.pcz.czest.pl

NAME OF LECTURER (s) (NAME, SURNAME, E-MAIL ADDRESS)

1. Agnieszka Popenda, apopenda@is.pcz.czest.pl

Learning outcome	In relation to the learning outcomes specified for the field of study	Course objectives	Course content	Course studymethods	Methods of assesment
EU 1	**K_W06 K_W08 K_W13 K_K01 K_U05**	**C.1**	lecture	**1**	**P1.**
EU 2	**K_W08 K_W13 K_U01 K_K05 K_U05**	**C.2**	lecture	**1**	**P1.**
EU 3	**K_W08 K_U01, K_U05, K_K01**	**C.3**	tutorials	**2**	**F1., F2., P1.**

II. OTHER USEFUL INFORMATION

1. All information on the class schedules will be posted on the information section board and on the website www.is.pcz.czest.pl
2. The information on office course will be provided by the lecturer during the first meeting with the students as well as will be posted on the Institute of Environmental Engineering website
3. The information on the grade requirements will be provided to the students during the first meeting

Course title: **Social acceptance of Renewable Energy Sources RES**		
Programme: **Intelligent Energy for Environmental Protection**		Code: **4.2**
Type of course: **Module 4, elective, block IA**	Course level: **II**	Semester: **I**
Form of classes: **Lecture**, **tutorial**	Number of hours per week: **2L, 2T**	Credit points: **4**
Education profile: **general academic**		Course language: **English**
Enrolment**: yes**		

SYLLABUS

I. COURSE CHART

COURSE OBJECTIVES

C.1. Providing the knowledge on RES application benefits
C.2. Explanation of social protests reasons related to application of RES
C.3. Mastering the basics of mediation

PRELIMINARY COURSE REQUIREMENTS FOR KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge on RES technologies
2. Ability to work in groups
3. Ability to search, use and interpret the literature sources

LEARNING OUTCOMES

EU 1 - Understanding the benefits of RES application
EU 2 - Understanding the reasons of opposition against RES
EU 3 - Mastering the basics of mediation

COURSE CONTENT

Form of classes - lectures	Hours
Introduction. Role of RES in enhancing the technical progress, overcoming of fuel crisis and global climate change.	2
Global benefits of RES application.	2
Local benefits of RES application.	2
Background of social protests against RES. Most common syndromes such as NIMBY, BANANA, CAVE.	2
How to distinguish scientific publication from para-scientific work.	2
Case-study: protest against wind energy.	2
Case study: protest against biomass power plant.	2
Legal aspects of RES localization	2

Efficient and precise communication. Misunderstanding as a most often reason of conflict.	2
Role and desired skills of the mediator. Ethics in mediation.	2
Tools for mediators.	2
How to prepare and conduct a meeting with a local society.	2
Participants in RES application and acceptance process. Role of local authorities and NGO's.	2
Strategy of negotiations and win-win theory.	2
Test	2
Form of classes - tutorials	**Hours**
Efficient promotion of RES	4
Environmental impact calculation and reporting	4
Comparison of emissions for various energy technologies	4
Presentation and discussion of selected RES technology	4
Mediation techniques exercising	4
Mediation techniques exercising	4
Mediation techniques exercising	4
Summary, credit entry	2

COURSE STUDY METHODS

1. Lectures comprising of multimedia presentation
2. Tutorial
3. Discussion, co-working

METHODS OF ASSESMENT (F - formative; S - summative)

F1 – evaluation of preparation for lectures
F2 - evaluation of preparation for tutorials
F3 – evaluation of activity during classes
P1 – test

STUDENT WORKLOAD

Form of activity	Workload (hours)
Participation in lectures	**28 h**
Participation in classes	**30 h**
Laboratory	**-h**
Participation in project classes	**-h**
Participation in seminar	**-h**
Preparation course on e-learning	**-h**
Test	**2 h**
Entrance test for laboratory classes	**-h**
Project's defence	**-h**
Exam	**-h**
Consultation hours	**3 h**
DIRECT TEACHING, hours/ ECTS	**63 h / 2,6 ECTS**

Preparation for tutorials	**20 h**
Preparation for laboratories	**-h**
Preparation for projects	**-h**
Preparation for seminars	**-h**
Preparation for e-learning classes	**-h**
Participation in e-learning classes	**-h**
Working on project	**-h**
Preparation for tests	**15 h**
Preparation for exam	**-**
SELF-STUDY, hours/ ECTS	**35 h / 1,4 ECTS**
TOTAL (hours)	**∑ 98 h**
TOTAL ECTS	**4 ECTS**

PRIMARY AND SUPPLEMENTARY TEXTBOOKS

1. Popkiewicz M., Rewolucja energetyczna. Ale po co? Wyd. Sonia Draga, 2015
2. Praca zbiorowa pod red. Księżopolski K.M. et al., Odnawialne źródła energii w Polsce. Wybrane problemy bezpieczeństwa, polityki i administracji, Dom Wydawniczy Elipsa, 2014
3. Pierpont N., Wind Turbine Syndrome: A Report on Natural Experiment, K-Selected Books, 2009
4. Etherington J., The Wind Farm Scam, Stacey International, 2009
5. Beer E.B., The Mediator's Handbook: Revised & Expanded fourth edition, New Society Publishers, 2012.
6. Alves-Pereira M., Castelo- Branco N.A.A., Vibroacoustic disease: Biological effects of infrasound and low-frequency noise explained by mechanotransduction cellular signalling, Progress in Biophysics and Molecular Biology, vol. 93, pp. 256-279, 2007.
7. Praca po red. Binsztok A., Sztuka skutecznego prowadzenia mediacji i negocjacji, zagadnienia psychologiczne i komunikacyjne, Wyd. Marina, 2013.

SUBJECT COORDINATOR (NAME, SURNAME, E-MAIL ADDRESS)

1. Rafał Rajczyk, rafalr@is.pcz.czest.pl

AME OF LECTURER (s) (NAME, SURNAME, E-MAIL ADDRESS)

1. Rafał Rajczyk, rafalr@is.pcz.czest.pl

Learning outcome	In relation to the learning outcomes specified for the field of study	Course objectives	Course content	Course study methods	Methods of assesment
EU1	**K_W05, K_U01, K_U03, K_U05**	**C1**	Lecture/ tutorials	**1,2,3**	**F1, F2, F3, P1**
EU2	**K_W05, K_U01, K_U05, K_K01**	**C2**	Lecture/ tutorials	**1,2,3**	**F1, F2, F3, P1**
EU3	**K_U03, K_U05, K_K01**	**C3**	Lecture/ tutorials	**1,2,3**	**F1, F2, F3, P1**

II. OTHER USEFUL INFORMATION

1. All the information on the class schedule is posted on the student information board and online at: www.is.pcz.pl
2. The information about the consultation hours is provided to students on the first class meeting and posted online at…
3. The information on course completion and grade is provided to students on the first class meeting.

Course title: **Waste for Material and Energy Recovery**		
Programme**:** **Intelligent Energy for Environmental Protection**		Code: **4.3**
Type of course: **Module 4, elective, block IB**	Course level: **II**	Semester: **I**
Form of classes: **lecture, laboratory**	Number of hours per week: **2L, 2LAB**	Credit points: **4**
Education profile: **general academic**		Course language: **English**
Enrolment**: yes**		

SYLLABUS

I. COURSE CHART

COURSE OBJECTIVES

C.1. knowledge transfer of waste management, including sewage sludge
C.2. skills in the range of basic parameters determination of waste management technological processes

PRELIMINARY COURSE REQUIREMENTS FOR KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. knowledge of mathematics, unit processes in the environmental engineering
2. skills of literature sources using
3. skills of logic thinking
4. manual skills during laboratory classes

LEARNING OUTCOMES

EU 1 - has knowledge of waste kinds, their properties and methods of waste management
EU 2 - has knowledge of systems and installations of waste management
EU 3 - has skills of technological processes parameters determination

COURSE CONTENT

Form of classes - lectures	Hours
Introduction to waste management: definitions, classfications and legal aspects	2
Different types of wastes	2
Methods of waste collection	2
Initial methods of waste preparation before its treatment	2
Methods of waste treatment: composting, dry anaerobic digestion	2
Methods of waste utilization	2
Waste management plan: objectives, waste streams, concepts, targets, realization and management	2
Sewage sludge characterisation	2
Sewage sludge conditioning	2
Sewage sludge thickening	2

Sewage sludge dewatering	2
Sewage sludge stabilisation	2
Drying processes of sewage sludge	3
Sewage sludge thermal utilization processes	3
Form of classes - laboratory	**Hours**
Methods of waste and sludge analysis	2
Determination of water content, dry mass in waste and sludge	2
Physical and chemical characterization of solid organic waste	2
Biodegradability of solid organic waste	2
Toxicity tests	2
Composting: selection of substrates and bulking agents	2
Composting: pile design	2
Determination of capillary suction time	2
Sludge conditioning	2
Vacuum filtration	2
Pressure filtration	2
Centrifugation of sludge	2
Sludge properties	2
Thermal drying of sludge	2
The proximate and ultimate analyses of sludge	2

COURSE STUDY METHODS

1. Lecture with multimedial presentations
2. Laboratory sets and devices

METHODS OF ASSESMENT (F - formative; S - summative)

F1. – assessment of individual preparation to classes
F2. – assessment of working in the group
S1. – credit test
S2. – assessment of laboratory exercises

STUDENT WORKLOAD

Form of activity	Workload (hours)
Participation in lectures	**30 h**
Participation in classes	**- h**
Laboratory	**30 h**
Participation in project classes	**- h**
Participation in seminar	**- h**
Preparation course on e-learning	**- h**
Test	**- h**
Entrance test for laboratory classes	**- h**
Project's defence	**- h**
Exam	**- h**
Consultation hours	**- h**
DIRECT TEACHING, hours/ ECTS	**30 h / 2 ECTS**
Preparation for tutorials	**20 h**

Preparation for laboratories **Preparation for projects** **Preparation for seminars** **Preparation for e-learning classes** **Participation in e-learning classes** **Working on project** **Preparation for tests** **Preparation for exam**	**25 h** **- h** **- h** **- h** **- h** **- h** **15 h** **- h**
SELF-STUDY, hours/ ECTS	**60 h / 2 ECTS**
TOTAL (hours)	**∑ 120 h**
TOTAL ECTS	**4 ECTS**

PRIMARY AND SUPPLEMENTARY TEXTBOOKS

L.Spinosa, Wastewater sludge: a global overview of the current status and future prospects, IWA Publishing 2007.
P. Foladori, G. Andreottola, G. Ziglio, Sludge Reduction Technologies in Wastewater Treatment Plants, IWA Publishing 2010.
J. Pichtel, Waste management practices: municipal, hazardous, and industrial, Taylor & Francis 2005.
M. F. Lemann, Waste Management; Peter Lang 2008.
Actual standards in the range of subject
T.P. Wagner, R. Sanford, Environmental Science: Active Learning Laboratories and Applied Problem Sets. Wiley and Sons 2009.
E. Epstein, Industrial Composting: Environmental Engineering and Facilities Management. SRS Press Taylor and Francis Group 2011.
L.Wolny, Double agent method of sludge conditioning, Environmental Engineering IV, Taylor & Francis Group, London, 2013, 203 – 206.
L.Wolny, Dewatering of conditioned sludge in small wastewater treatment plants, Environment Protection Engineering, Vol. 41, nr 2, 2015, 99-105.
P.T. William;Waste Treatment and Disposal, 2nd edition, Wiley 2005.
A. Elsner, Sewage Sludge: Treatment and Utilization of Sludge; The Drying of Sludge; Operation of Mechanical Sewage Plants; Sludge Treatment in the United States, 2017
Z. Guangyin, Z. Youcai, Pollution Control and Resource Recovery for Sewage Sludge, 2017

SUBJECT COORDINATOR (NAME, SURNAME, E-MAIL ADDRESS)

1. Lidia Wolny, wolny@is.pcz.czest.pl

NAME OF LECTURER (s) (NAME, SURNAME, E-MAIL ADDRESS)

1. Krystyna Malinska, kmalinska@is.pcz.czest.pl,
2. Jurand Bien, jurand@is.pcz.pl

Learning outcome	In relation to the learning outcomes specified for the field of study	Course objectives	Course content	Course study methods	Methods of assesment
EU 1	**K_W08, K_W09, K_U05**	**C.1**	Lecture	**1**	**S1**
EU 2	**K_U05, K_U10**	**C.1**	Lecture	**1**	**S1, F1, F2**
EU 3	**K_U05, K_K01, K_K02**	**C.2**	Laboratory	**2**	**S2, F2**

II. OTHER USEFUL INFORMATION

1. All the information on the class schedule is posted on the student information board and online at: www.is.pcz.pl
2. The information about the consultation hours is provided to students on the first class meeting and posted online at…
3. The information on course completion and grade is provided to students on the first class meeting.

Course title: **Waste management in power industry**		
Programme**:** **Intelligent Energy for Environmental Protection**		Code: **4.4**
Type of course: **Module 4, elective, block IB**	Course level: **II**	Semester: **I**
Form of classes: **Lecture, laboratory**	Number of hours per week: **2L, 2Lab**	Credit points: **4**
Education profile: **general academic**		Course language: **English**
Enrolment**: yes**		

SYLLABUS

I. COURSE CHART

COURSE OBJECTIVES

C.1. knowledge transfer of waste management in energy sector
C.2. skills in the range of basic parameters determination in waste management technological processes

PRELIMINARY COURSE REQUIREMENTS FOR KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. knowledge of mathematics
2. general knowledge of engineering processes in power industry
3. skills of logic thinking
4. manual skills during laboratory classes

LEARNING OUTCOMES

EU 1 - has knowledge of waste generated in power sector
EU 2 - has knowledge of procedures and requirements in waste management
EU 3 - has knowledge of systems and installations of waste management
EU 4 - has skills of technological processes parameters determination

COURSE CONTENT

Form of classes - lectures	Hours
Steam electric power generation industry – an introduction	2
Waste source in steam electric power generation industry	2
Characterization of wastewater	2
Characterization of cooling water	2
Low-volume waste sources	4
Metal cleaning wastes	2
End-of-pipe treatment technologies	2
Solid–liquid separation technologies	4
Characterization of ash	2
Methods of ash utilisation	4

Hazardous waste management	2
Form of classes - laboratory	**Hours**
Introduction to laboratory set; safety issues	2
Local visit at the power industry facility	6
Preparation the permission to generate waste at the power facility	14
Determination of ash content	4
Determination of specific mineral content in ash	4

COURSE STUDY METHODS

1. Lecture with multimedial presentaions
2. Laboratory set and devices

METHODS OF ASSESMENT (F - formative; S - summative)

F1. – assessment of individual preparation to classes
F2. – assessment of working in groups
S1. – credit test
S2. – assessment of laboratory exercises

STUDENT WORKLOAD

Form of activity	Workload (hours)
Participation in lectures	**30 h**
Participation in classes	**- h**
Laboratory	**30 h**
Participation in project classes	**- h**
Participation in seminar	**- h**
Preparation course on e-learning	**- h**
Test	**- h**
Entrance test for laboratory classes	**- h**
Project's defence	**- h**
Exam	**- h**
Consultation hours	**- h**
DIRECT TEACHING, hours/ ECTS	**60 h / 2 ECTS**
Preparation for tutorials	**20 h**
Preparation for laboratories	**25 h**
Preparation for projects	**- h**
Preparation for seminars	**- h**
Preparation for e-learning classes	**- h**
Participation in e-learning classes	**- h**
Working on project	**- h**
Preparation for tests	**15 h**
Preparation for exam	**- h**
SELF-STUDY, hours/ ECTS	**60 h / 2 ECTS**
TOTAL (hours)	**∑ 120 h**
TOTAL ECTS	**4 ECTS**

PRIMARY AND SUPPLEMENTARY TEXTBOOKS

M. F. Lemann; Waste Management; Peter Lang 2008.
P.T. William;Waste Treatment and Disposal, 2nd edition, Wiley 2005.
N.P. Cheremisinoff; Handbook of Solid Waste Management and Waste Minimization Technologies, 2003
S. Anand Kumar Varma; Principles of Industrial Waste Management, 2017
L.K. Wang, Yung-Tse Hung, H.H. Lo, C Yapijakis; Waste Treatment in the Process Industries, 2005

SUBJECT COORDINATOR (NAME, SURNAME, E-MAIL ADDRESS)

1. Jurand Bień, jurand@is.pcz.pl

NAME OF LECTURER (s) (NAME, SURNAME, E-MAIL ADDRESS)

1. Jurand Bień, jurand@is.pcz.pl

Learning outcome	In relation to the learning outcomes specified for the field of study	Course objectives	Course content	Course study methods	Methods of assesment
EU 1	**K_W08, K_W09 K_U03, K_U05 K_U10**	**C.1**	Lecture	**1**	**S1, F1, F2**
EU 2					
EU 3					
EU 4	**K_U10, K_K01, K_K02**	**C.2**	Laboratory	**2**	**S2, F1, F2**

II. OTHER USEFUL INFORMATION

1. All the information on the class schedule is posted on the student information board and online at: www.is.pcz.pl
2. The information about the consultation hours is provided to students on the first class meeting and posted online at…
3. The information on course completion and grade is provided to students on the first class meeting.

Course title: **Biomass Harvesting and Utilization**		
Programme: **Intelligent Energy for Environmental Protection**		Code: **4.5**
Type of course: **Module 4, elective, block IC**	Course level: **II**	Semester: **I**
Form of classes: **Lectures, project**	Number of hours per week/meeting: **2L, 2P**	Credit points: **4**
Education profile: **generally academic**		Course language: **English**
Enrolment: **yes**		

SYLLABUS

I. COURSE CHART

COURSE OBJECTIVES

C.1. Providing basic knowledge about biomass cropping systems, harvesting methods, and costs
C.2. Providing of basic knowledge about biomass heating and power applications and alternative conversion technologies
C.3. Providing knowledge about basic economic analysis, calculations, biomass utilization case studies

PRELIMINARY COURSE REQUIREMENTS FOR KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge from geology, chemistry
2. Knowledge from biology of living organisms
3. Basic knowledge from environmental protection

LEARNING OUTCOMES

EU 1 - Knows harvesting methods, factors and costs
EU 2 - Has the knowledge about conducting biomass supply assessments
EU 3 - Knows how to measure biomass and apply conversion factors
EU 4 - Has knowledge about biomass heating and power applications, knows the alternative conversion technologies
EU 5 - Can prepare basic economic analysis, calculate case studies to develop biomass utilization projects

COURSE CONTENT

Form of classes - lectures	Hours
Introduction, biomass types, plants	4
Rules and recommendations affecting biomass harvesting	4
Certification systems	4
Biomass power generation	4
Ecological sustainability of forest biomass harvesting	4
Forest biomass utilization	4

Environmental factors in biomass harvesting	4
Knowledge test	2
Form of classes - tutorials	**Hours**
Biomass harvesting and utilization - introduction	2
Case study based on bibliographic data: - Examining the social acceptability of forest biomass harvesting and utilization from collaborative forest landscape restoration: A case study - Biomass production and allocation in cereals with implications for straw harvesting and utilization - Project case studies- biomass from residual sources	20
Presentation from the three topics	6
Final test and results	2

COURSE STUDY METHODS

4.	blackboard, interactive whiteboard
5.	multimedia presentation
6.	Literature from on-line bibliographic databases

METHODS OF ASSESMENT (F - formative; S - summative)

F1. – activity in classes
S1. – test from the lectures
S2. – test and presentation from the tutorials
S3. - evaluation of the tutorials reports performance including analysis and verification of the obtained results

STUDENT WORKLOAD

Form of activity	Workload (hours)
Participation in lectures	**28 h**
Participation in classes	**- h**
Laboratory	**- h**
Participation in project classes	**28 h**
Participation in seminar	**- h**
Preparation course on e-learning	**- h**
Test	**4 h**
Entrance test for laboratory classes	**- h**
Project's defence	**- h**
Exam	**- h**
Consultation hours	**10 h**
DIRECT TEACHING, hours/ ECTS	**70 h / 2,8 ECTS**
Preparation for tutorials	**- h**
Preparation for laboratories	**- h**
Preparation for projects	**15 h**
Preparation for seminars	**- h**
Preparation for e-learning classes	**- h**
Participation in e-learning classes	**- h**
Working on project	**- h**

Preparation for tests **Preparation for exam**	**15 h** **- h**
SELF-STUDY, hours/ ECTS	**30 h / 1,2 ECTS**
TOTAL (hours)	**∑ 100 h**
TOTAL ECTS	**4 ECTS**

PRIMARY AND SUPPLEMENTARY TEXTBOOKS

Aguilar, F., and H. E. G. Garrett. 2009. Perspectives of Woody Biomass for Energy: Survey of State Foresters, State Energy Biomass Contacts, and National Council of Forestry Association Executives. Journal of Forestry 107(6):297-306. 2 Ahtikoskia, A., J. Heikkila, V.
Aleniusa, and M. Sirenc. 2008. Economic Viability of Utilizing Biomass Energy from Young Stands-the Case of Finland. Biomass and Bioenergy 32:988 - 996. 3 Aijala, O., K. M., and M. Halonen. 2005. Energy Wood Harvest from Clear Cuts, Guidelines. Quality Project of Energy Wood Harvest in Clear Cut. Feric Tapio Guidelines. Finland. 4 Andersson, G., A. Asikainen, R. Björheden, P. W. Hall, J. B. Hudson, R. Jirjis, D. J. Mead

SUBJECT COORDINATOR (NAME, SURNAME, E-MAIL ADDRESS)

1. Anna Grobelak, agrobelak@is.pcz.czest.pl

NAME OF LECTURER (s) (NAME, SURNAME, E-MAIL ADDRESS)

1. Anna Grobelak, agrobelak@is.pcz.czest.pl

Learning outcome	In relation to the learning outcomes specified for the field of study	Course objectives	Course content	Course study methods	Methods of assesment
EU 1	**K_W05, K_U01, K_U02, K_U05, K_U06, K_K01**	**C.1-2**	**lecture/ project**	**1-2**	**S1**
EU 2	**K_W05, K_U01, K_U02, K_U05, K_U06, K_K01**	**C.1-2**	**lecture/ project**	**1-2**	**S1**
EU 3-EU 5	**K_W05, K_U01, K_U02, K_U05, K_U06, K_K01**	**C.3**	**project**	**3**	**F1, S2-3**

II. OTHER USEFUL INFORMATION

1. All the information on the class schedule is posted on the student information board and online at: www.is.pcz.pl
2. The information about the consultation hours is provided to students on the first class meeting and posted online at …
3. The information on course completion and grade is provided to students on the first class meeting.

Course title: **New Technologies in Water and Wastewater Treatment**		
Programme: **Environmental Engineering**		Code: **4.6**
Type of course: **Module 4, elective, block IC**	Course level: **II**	Semester: **I**
Form of classes: **Lecture, tutorial**	Number of hours per week/meeting: **2L, 2T**	Credit points: **4**
Education profile: **general academic**		Course language: **English**
Enrolment: **yes**		

SYLLABUS

I. COURSE CHART

COURSE OBJECTIVES

C.1. To inform the students about state in the art in the field of water and wastewater treatment and developmental trends in this area

C.2. To teach students how to design water and wastewater treatment processes taking into consideration the newest trends in technology

PRELIMINARY COURSE REQUIREMENTS FOR KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basics of water and wastewater treatment in accordance with study program at bachelors level
2. Basics of engineering calculations

LEARNING OUTCOMES

EU 1 -knows state of the art. in the area of water and wastewater treatment, is able to determine the trends in this regard

EU 2 -is able to design treatment technology of water or wastewater ta king into consideration state in the art in this regard

COURSE CONTENT

Form of classes - lectures	Hours
Trends in water and wastewater treatment	2
Study visit in modern water treatment plant	2
Biological processes in water treatment	2
Integrated chemical and biological treatment technologies of water treatment	2
Advanced oxidation processes in water treatment	2
Advances in coagulation of water	2
Ion exchange in water treatment	2
Use of advanced oxidation methods in wastewater treatment	2
Study visit in wastewater treatment plant	2

New technologies in waste products utilization	2
Integrated and compact systems in wastewater treatment	2
Use of algae in wastewater treatment	2
Recovery of metals in wastewater treatment	2
Use of anaerobic methods for wastewater treatment	2
Use of membrane processes in wastewater treatment	1
Colloquium	1
Form of classes - tutorials	**Hours**
Individual tutorial project on water or wastewater treatment technology	30

COURSE STUDY METHODS

1. blackboard
2. multimedia presentation
3. computer workstation

METHODS OF ASSESMENT (F - formative; S - summative)

F1. – activity in classes
S1. – final test
S2. – defense of project

STUDENT WORKLOAD

Form of activity	Workload (hours)
Participation in lectures	**29 h**
Participation in classes (tutorial)	**30 h**
Laboratory	**- h**
Participation in project classes	**- h**
Participation in seminar	**- h**
Preparation course on e-learning	**- h**
Test	**1 h**
Entrance test for laboratory classes	**- h**
Project's defence	**- h**
Exam	**- h**
Consultation hours	**- h**
DIRECT TEACHING, hours/ ECTS	**60h / 2 ECTS**
Preparation for tutorials	**30 h**
Preparation for laboratories	**- h**
Preparation for projects	**- h**
Preparation for seminars	**- h**
Preparation for e-learning classes	**- h**
Participation in e-learning classes	**- h**
Working on project	**- h**
Preparation for tests	**30 h**
Preparation for exam	**- h**
SELF-STUDY, hours/ ECTS	**60 h / 2 ECTS**
TOTAL (hours)	**∑ 120 h**
TOTAL ECTS	**4 ECTS**

PRIMARY AND SUPPLEMENTARY TEXTBOOKS

Pizzi N.: Water Treatment, Principles and Practices of Water Supply Operations, AWWA, Denver 2010
Hendrics D.: Water Treatment Unit Processes. Physical and Chemical, CRC Press, Boca
Nowak R., Wiśniowska E., Włodarczyk-Makuła M., Effectiveness of Degradation and Removal of Non-Steroidal Pharmaceuticals which are the Most Frequently Identified in Surface Water, Desalination and Water Treatment, Vol. 134, 211-223, 2018
Wiśniowska E., Włodarczyk-Makuła M., State of the Art in Technologies of the Biogas Production Increasing During Methane Digestion of Sewage Sludge, Civil and Environmental Engineering Reports, vol. 1. nr 28, 64-76, 2018
Actual research and technical journals on environmental engineering

SUBJECT COORDINATOR (NAME, SURNAME, E-MAIL ADDRESS)

1. Ewa Wiśniowska, ewisniowska@is.pcz.czest.pl

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1. Ewa Wiśniowska, ewisniowska@is.pcz.czest.pl

Learning outcome	In relation to the learning outcomes specified for the field of study	Course objectives	Course content	Course study methods	Methods of assesment
EU 1	**K_W08, K_W09, K_W13, K_U05,**	**C.1.**	Lecture	**1, 2**	**F1., S1.**
EU 2	**K_U01, K_U05, K_K01**	**C.2.**	Tutorial	**1, 2, 3**	**S2.**

II. OTHER USEFUL INFORMATION

1. All the information on the class schedule is posted on the student information board and online at: www.is.pcz.pl
2. The information about the consultation hours is provided to students on the first class meeting and posted online at www.is.pcz.pl
3. The information on course completion and grade is provided to students on the first class meeting.

Course title: **Industrial wastewater technologies**		
Programme**:** **Intelligent Energy for Environmental Protection**		Code: **4.7**
Type of course: **Module 4, elective, block IIA**	Course level: **II**	Semester: **II**
Form of classes: **Lecture, laboratory**	Number of hours per week: **2L, 2 Lab**	Credit points: **4**
Education profile: **general academic**		Course language: **English**
Enrolment**: yes**		

SYLLABUS

I. COURSE CHART

COURSE OBJECTIVES

C.1. Knowledge regarding the treatment of industrial wastewater
C.2. The skills of laboratory tests

PRELIMINARY COURSE REQUIREMENTS FOR KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Instrumental methods in chemistry
2. Water and wastewater technology

LEARNING OUTCOMES

EU 1 - Qualitative characteristics of industrial wastewater
EU 2 - Technologies for treatment of industrial wastewater
EU 3 - Laboratory skills in wastewater technology

COURSE CONTENT

Form of classes - lectures	**Hours**
Characteristic of industrial wastewater	5
Legal regulation regarding the treatment of industrial wastewater	4
Physical methods of industrial wastewater treatment(filtration, flotation, coagulation, adsorption, stripping, membrane separation processes)	5
Chemical and photochemical methods of industrial wastewater treatment	5
Biological methods of industrial wastewater treatment	5
Application of integrated methods of industrial wastewater treatment	4
Test	2
Form of classes - laboratory	**Hours**
Fundamentals of laboratory research	6
Chemical oxidation of organic compounds in industrial wastewater	8
Photo-chemical oxidation of organic compounds in industrial wastewater	8

Removal of specific pollutants (toxic, persistent and priority compounds) from industrial wastewater	8

COURSE STUDY METHODS

1. Power- point presentation
2. Laboratory activities

METHODS OF ASSESMENT (F - formative; S - summative)

F1. – evaluation of independent preparation for tasks
F2. - assessment of group work in solving tasks in class
S1. – final test of lectures
S2.- training session

STUDENT WORKLOAD

Form of activity	Workload (hours)
Participation in lectures	**30 h**
Participation in classes	**- h**
Laboratory	**30 h**
Participation in project classes	**- h**
Participation in seminar	**- h**
Preparation course on e-learning	**- h**
Test	**- h**
Entrance test for laboratory classes	**- h**
Project's defence	**- h**
Exam	**- h**
Consultation hours	**- h**
DIRECT TEACHING, hours/ ECTS	**60 h / 2 ECTS**
Preparation for tutorials	**- h**
Preparation for laboratories	**35 h**
Preparation for projects	**- h**
Preparation for seminars	**- h**
Preparation for e-learning classes	**- h**
Participation in e-learning classes	**- h**
Working on project	**- h**
Preparation for tests	**25 h**
Preparation for exam	**- h**
SELF-STUDY, hours/ ECTS	**60 h / 2 ECTS**
TOTAL (hours)	**∑ 120 h**
TOTAL ECTS	**4 ECTS**

PRIMARY AND SUPPLEMENTARY TEXTBOOKS

F. Woodard, Industrial Waste Treatment Handbook, British Library Cataloguing-in-Publication Data Butterworth–Heinemann, 2001
W. Jern, Industrial Wastewater Treatment, Imperial College Press, London, 2006

Wang L.K., Pereira N.C., Young-Tse H., Biological treatment processes, Handbook of Environmental Engineering, vol. 8, Humana Press, Mill Spring 2009
Mielczarek K., Bohdziewicz J., **Włodarczyk-Makuła M.**, Smol M., Comparison of post-process coke wastewater treatment effectiveness in integrated and hybrid systems that combine coagulation, ultrafiltration and reverse osmosis, Desalination and Water Treatment, 52, 19-21, 2014, 3879-3888, DOI:10.1080/19443994.2014.887500
Bajdur W.M., **Włodarczyk-Makuła M.,** Idzikowski A., A new synthetic polymers used in removal of pollutants from industrial effluents, Desalination and Water Treatment, 57, 3, 2016, 1038 - 1049, **DOI:** 10.1080/19443994.2015.1043495
Archives of Environmental Protection - journal
Polish journal of Environmental Studies - journal
Polish and UE legislation documents

SUBJECT COORDINATOR (NAME, SURNAME, E-MAIL ADDRESS)

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NAME OF LECTURER (s) (NAME, SURNAME, E-MAIL ADDRESS)

1. Maria Włodarczyk-Makuła, mwm@is.pcz.czest.pl

Learning outcome	In relation to the learning outcomes specified for the field of study	Course objectives	Course content	Course study methods	Methods of assesment
EU 1	**K_W08, K_U05,**	**C1**	Lectures	**1**	**F.1**
EU 2	**K_W08, K_U05,**	**C1**	Lectures	**1**	**F.1**
EU 3	**K_U02, K_U05,**	**C2**	Laboratory	**2**	**F.2, S.1,S.2**

II. OTHER USEFUL INFORMATION

1. All the information on the class schedule is posted on the student information board and online at: www.is.pcz.pl
2. The information about the consultation hours is provided to students on the first class meeting and posted online at…
3. The information on course completion and grade is provided to students on the first class meeting.

Course title: **Wastewater Treatment Processing Design - Project**		
Programme: **Environmental engineering**		Code: **4.8**
Type of course: **Module 4, elective, block IIA**	Course level: **II**	Semester: **II**
Form of classes: **Lecture, project**	Number of hours per week/meeting: **2L, 2P**	Credit points: **4**
Education profile: **general academic**		Course language: **English**
Enrolment: **yes**		

SYLLABUS

I. COURSE CHART

COURSE OBJECTIVES

C.1. To provide the knowledge on the methodology of technological designing of wastewater treatment by activated sludge

C.2. To teach the students how to use computer software to design biological wastewater treatment plants

PRELIMINARY COURSE REQUIREMENTS FOR KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basics of wastewater treatment technologies according to the I-st cycle (bachelor) degree
2. Basics of engineering calculations
3. To be able to use spreadsheet programs (Excel or other similar)

LEARNING OUTCOMES

EU 1 -can, in accordance with the given specification design the process of wastewater treatment using the right methods

EU 2 -can design wastewater treatment technologies using a computer program

COURSE CONTENT

Form of classes - lectures	**Hours**
Balancing quantity and quality of wastewater	4
Designing of wastewater treatment plant according to ATVA131P Method – theoretical basis of biological treatment with BNR and without	25
Test	1
Form of classes - project	**Hours**
Project of wastewater treatment plant according to ATVA131P Method based on the given specification	29
Defense of project	1

COURSE STUDY METHODS

1. blackboard
2. multimedia presentation
3. computer workstation

METHODS OF ASSESMENT (F - formative; S - summative)

F1. – activity in classes
S1. – final test
S2. – defense of project

STUDENT WORKLOAD

Form of activity	Workload (hours)
Participation in lectures	**29 h**
Participation in classes	**- h**
Laboratory	**- h**
Participation in project classes	**29 h**
Participation in seminar	**- h**
Preparation course on e-learning	**- h**
Test	**1 h**
Entrance test for laboratory classes	**- h**
Project's defence	**1 h**
Exam	**- h**
Consultation hours	**- h**
DIRECT TEACHING, hours/ ECTS	**60 h / 2 ECTS**
Preparation for tutorials	**- h**
Preparation for laboratories	**- h**
Preparation for projects	**15 h**
Preparation for seminars	**- h**
Preparation for e-learning classes	**- h**
Participation in e-learning classes	**- h**
Working on project	**15 h**
Preparation for tests	**30 h**
Preparation for exam	**- h**
SELF-STUDY, hours/ ECTS	**60 h / 2 ECTS**
TOTAL (hours)	**∑ 120 h**
TOTAL ECTS	**4 ECTS**

PRIMARY AND SUPPLEMENTARY TEXTBOOKS

ATV-DVWK-A 131 "Dimensioning of Single-Stage Activated Sludge Plants", Actual version
Wiśniowska E., COD Fractions in Supernatants and Leachates in WWTP, SSCHE 2014. 41st International Conference of Slovak Society of Chemical Engineering. Tatranske Matliare, Slovakia, May 26-30. Proceedings, 149-150 , 2014
Wiśniowska E. Zintegrowane systemy przeróbki odpadów w oczyszczalniach ścieków. Seria Monografie nr 311. Częstochowa: Wyd Politechniki Częstochowskiej; 2016. ISBN: 9788371936449.

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1. Ewa Wiśniowska, ewisniowska@is.pcz.czest.pl

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1. Ewa Wiśniowska, ewisniowska@is.pcz.czest.pl

Learning outcome	In relation to the learning outcomes specified for the field of study	Course objectives	Course content	Course study methods	Methods of assesment
EU 1	**K_W08, K_U05**	**C.1.**	Lecture	**1, 2**	**F1., S1.**
EU 2	**K_U01, K_U02, K_U05, K_U06**	**C.2.**	Project	**3**	**S2.**

II. OTHER USEFUL INFORMATION

1. All the information on the class schedule is posted on the student information board and online at: www.is.pcz.pl
2. The information about the consultation hours is provided to students on the first class meeting and posted online at www.is.pcz.pl
3. The information on course completion and grade is provided to students on the first class meeting.

Course title: **Management of energy conversion by-products**		
Programme: **Intelligent energy for environmental protection**		Code: **4.9**
Type of course: **Module 4, elective, block IIB**	Course level: **II**	Semester: **II**
Form of classes: **lecture, project**	Number of hours per week/meeting: **2L, 2P**	Credit points: **4**
Education profile: **general academic**		Course language: **English**
Enrolment: **yes**		

SYLLABUS

I. COURSE CHART

COURSE OBJECTIVES

C.1. Transfer of knowledge on fundamentals of management energy conversion by-products
C.2. Transfer of knowledge on energy conversion
C.3. Transfer of knowledge on technologies of energy conversion by-products

PRELIMINARY COURSE REQUIREMENTS FOR KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge on basic concepts relating to energy conversion
2. Skill in the field of calculation of management of energy conversion by-products
3. Ability to independently use of technical literature

LEARNING OUTCOMES

EU 1 - has knowledge on management of energy conversion by-products
EU 2 - has knowledge on energy conversion
EU 3 - has knowledge on technologies transformation of energy conversion by-products

COURSE CONTENT

Form of classes - lectures	**hours**
Energy conversion and energy conversion by-products	4
Combustion of fuels	4
Emission of gaseous and dust pollutants	4
Calculation of pollutant emission	4
Economics of gas cleaning processes	4
Resources of industrial waste energy, recovery boilers	4
Impact of energy technologies on the environment	4
Final test	2
Form of classes - project	**hours**

Introduction, basic physical quantities and units used in calculations relating to management of energy conversion by-products	2
Calculation of project	26
Verification of project	2

COURSE STUDY METHODS

1. Lectures using multimedia presentations
2. Demonstration of equipment, technical diagrams and methodological materials relating to the measurement methods and technologies that have been used in project

METHODS OF ASSESMENT (F - formative; S - summative)

F1. – assessment self-preparation for classes
F2. – assessment of response to questions and problems posed to students during lectures meetings
P1. – verification of comprehension of discussed calculation examples, diagrams and technologies used in project

STUDENT WORKLOAD

Form of activity	Workload (hours)
Participation in lectures	**15 h**
Participation in classes	**- h**
Laboratory	**- h**
Participation in project classes	**30 h**
Participation in seminar	**- h**
Preparation course on e-learning	**- h**
Test	**5 h**
Entrance test for laboratory classes	**- h**
Project's defence	**5 h**
Exam	**- h**
Consultation hours	**- h**
DIRECT TEACHING, hours/ ECTS	**55 h / 2,1 ECTS**
Preparation for tutorials	**- h**
Preparation for laboratories	**- h**
Preparation for projects	**20 h**
Preparation for seminars	**- h**
Preparation for e-learning classes	**- h**
Participation in e-learning classes	**- h**
Working on project	**15 h**
Preparation for tests	**15 h**
Preparation for exam	**- h**
SELF-STUDY, hours/ ECTS	**50 h / 1,9 ECTS**
TOTAL (hours)	**∑ 105 h**
TOTAL ECTS	**4 ECTS**

PRIMARY AND SUPPLEMENTARY TEXTBOOKS

R. Janka Zanieczyszczenia pyłowe i gazowe, Wydawnictwo Naukowe PWN, 2014
Przemysłowa energia odpadowa, WNT, 1993
J. Nadziakiewicz, K. Wacławiak, S. Stelmach, Procesy termiczne utylizacji odpadów, Wyd. P.Śl., 2012
Kordylewski W. Spalanie i paliwa, OWPWr, Wrocław, 2004
Sasinowski H., Energetyka a środowisko, Wyd. Polit. Białostockiej, 1996
Michał Wichliński,Rafał Kobyłecki, Zbigniew Bis; BADANIA ZAWARTOŚCI RTĘCI W PŁYTACH GIPSOWO-KARTONOWYCH I GIPSACH; JOURNAL OF CIVIL ENGINEERING, ENVIRONMENT AND ARCHITECTURE JCEEA, t. XXXIII, z. 63 (4/16), październik-grudzień 2016, s. 565-572
Rafał KOBYŁECKI, Michał WICHLIŃSKI, Zbigniew BIS; Badania akumulacji rtęci w popiołach lotnych z kotłów fluidalnych; POLITYKA ENERGETYCZNA,Tom 12 Zeszyt 2/2, 2009

SUBJECT COORDINATOR (NAME, SURNAME, E-MAIL ADDRESS)

1. Michał Wichliński, mwichlinski@is.pcz.czest.pl

NAME OF LECTURER (s) (NAME, SURNAME, E-MAIL ADDRESS)

1. Michał Wichliński, mwichlinski@is.pcz.czest.pl

Learning outcome	In relation to the learning outcomes specified for the field of study	Course objectives	Course content	Course study methods	Methods of assesment
EU 1	**K_W08, ,K_U02, K_U05**	**C.1**	Lecture	**1,2**	**F1,P1,P2**
EU 2	**K_W08, K_U02, K_U05**	**C.2**	Lecture	**1,2**	**F2,P2,**
EU 3	**K_W08, K_U02 K_U05**	**C.3**	Project	**1,2**	**F2,P2,**

II. OTHER USEFUL INFORMATION

1. All the information on the class schedule is posted on the student information board and online at: www.is.pcz.pl
2. The information about the consultation hours is provided to students on the first class meeting and posted online at the Department of Energy Engineering
3. The information on course completion and grade is provided to students on the first class meeting.

Course title: **Waste Heat Management and Energy Efficiency**		
Programme: **Intelligent energy for environmental protection**		Code: **4.10**
Type of course: **Module 4, elective, block IIB**	Course level: **II**	Semester: **II**
Form of classes: **lecture, laboratory**	Number of hours per week/meeting: **2L, 2Lab**	Credit points: **4**
Education profile: **general academic**		Course language: **English**
Enrolment: **yes**		

SYLLABUS

I. COURSE CHART

COURSE OBJECTIVES

C.1. Getting acquainted with thermal processing technologies and waste heat management.
C.2. Knowledge on analysis and calculation of waste heat reuse.

PRELIMINARY COURSE REQUIREMENTS FOR KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge on the fundamentals of thermodynamics, combustion, and energy conversion.
2. Ability for independent study of the literature and the use of computer software.

LEARNING OUTCOMES

EU 1 - Knowledge on the identification of waste heat formation sources.
EU 2 - Knowledge on how to solve basic problems associated with waste heat reuse.

COURSE CONTENT

Form of classes - lectures	hours
Introduction to power generation. Identification of potential waste heat production sources.	2
Fundamentals on thermodynamic calculation of waste heat production.	2
Low temperature waste heat recovery from the flue gases.	4
Condensation of flue gas moisture. Heat exchangers for condensating fluids.	4
Tools and devices for waste heat recovery from the flue gas. Heat pumps and chillers.	2
Potential possibilities to reuse low temperature waste heat at power production systems (condensation, CHP, polygeneration).	4
Waste heat recovery from the cooling of steam condensers. The possibilities to reuse the heat.	4
The recovery and reuse of heat from CO2 compression. Waste heat recovery from ORC systems. Waste heat recovery from off-water and sludges.	4
Accumulation possibilities of low temperature waste heat.	2

Discussion and written test.	2
Form of classes - laboratory	**hours**
Introduction. Info on the rules to pass the classes. Identification of waste heat generation sources. Calculation and balance of Energy conversion and power generation systems.	4
Calculation of waste heat in the flue gases.	2
Heat recovery from the flue gas by the condensation of moisture – calculation of some chosen cases.	4
Calculation of a condensation heat exchanger.	2
Modelling of thermal cycles for energy conversion and power generation – some chosen cases (basic, CHP, heat recovery, etc.).	6
Thermal calculation and modelling of the cooling system for power generation – some chosen cases (basic, CHP, heat recovery, etc.).	6
Modelling of some example systems with CO2 compression with intermittent cooling and heat recovery. Modelling of an example ORC system. Modelling of an example waste heat accumulation system.	4
Discussion and Test.	2

COURSE STUDY METHODS

1. Lectures using multimedia presentations
2. Laboratory activities with the use of advanced software for modeling of thermal processes. Analysis of some example cases, discussion and analysis of the results.

METHODS OF ASSESMENT (F - formative; S - summative)

F1. – assessment self-preparation for classes
F2. – assessment of student's activity during the classes
S1. – verification of student's knowledge (discussion and written test).

STUDENT WORKLOAD

Form of activity	**Workload (hours)**
Participation at lectures	**30 h**
Participation at classes	**- h**
Laboratory	**30 h**
Participation at project classes	**- h**
Participation at seminar	**- h**
Preparation course on e-learning	**- h**
Test	**2 h**
Entrance test for laboratory classes	**- h**
Project's defence	**- h**
Exam	**- h**
Consultation hours	**15 h**
DIRECT TEACHING, hours/ ECTS	**77 h / 2,9 ECTS**
Preparation for tutorials	**- h**
Preparation for laboratories	**15 h**
Preparation for projects	**h**
Preparation for seminars	**- h**
Preparation for e-learning classes	**- h**

Participation in e-learning classes **Working on project** **Preparation for tests** **Preparation for exam**	**- h** **- h** **15 h** **- h**
SELF-STUDY, hours/ ECTS	**30 h / 1,1 ECTS**
TOTAL (hours)	**∑ 107 h**
TOTAL ECTS	**4 ECTS**

PRIMARY AND SUPPLEMENTARY TEXTBOOKS

Thurmann A., Waste Heat Recovery Handbook, Spon Press, 1983.
http://www.chemengonline.com/waste-heat-recovery-methods-and-technologies/?printmode=1
http://www.em-ea.org/guide%20books/book-2/2.8%20waste%20heat%20recovery.pdf
Wójs K.: Odzysk i zagospodarowanie niskotemperaturowego ciepła odpadowego ze spalin wylotowych, PWN, Warszawa 2015.
Books, newspapers and magazines available via internet, as well as those found in the Science Library.

SUBJECT COORDINATOR (NAME, SURNAME, E-MAIL ADDRESS)

1. Robert Zarzycki, zarzycki@is.pcz.pl

NAME OF LECTURER (s) (NAME, SURNAME, E-MAIL ADDRESS)

1. Rafał Kobyłecki, rafalk@is.pcz.pl
2. Robert Zarzycki, zarzycki@is.pcz.pl

Learning outcome	In relation to the learning outcomes specified for the field of study	Course objectives	Course content	Course study methods	Methods of assesment
EU 1	**K_W08, K_U01, K_U02, K_K05, K_U06**	**C.1, C.2**	Lecture/ laboratory	**1, 2**	**F1, F2, S1**
EU 2	**K_W08, K_U01, K_U02, K_K05, K_U06**	**C.1, C.2**	Lecture/ laboratory	**1, 2**	**F1, F2, S1**

II. OTHER USEFUL INFORMATION

1. All the information on the class schedule is posted on the student information board and online at: www.is.pcz.pl
2. The information about the consultation hours is provided to students during the first meeting and posted online at the Faculty web page.
3. The information on the rules to complete the course is provided to students during the first meeting.

Course title: **Circular economy in environment**		
Programme: **Intelligent Energy for Environmental Protection**		Code: **4.11**
Type of course: **Module 4, elective, block IIC**	Course level: **II**	Semester: **II**
Form of classes: **Lecture, Tutorials**	Number of hours per week/meeting: **2L, 1T**	Credit points: **3**
Education profile: **generale academic**		Course language: **English**
Enrolment: **yes**		

SYLLABUS

I. COURSE CHART

COURSE OBJECTIVES

C.1. an understanding of the core concepts of circular economy, supply chains and waste,
C.2. use of critical thinking in practical applications of circular economy concepts in business settings;
C.3. provide experience in the expectations of a business environment

PRELIMINARY COURSE REQUIREMENTS FOR KNOWLEDGE, SKILLS AND OTHER COMPETENCES

3. Basic knowledge about biogeochemistry,
4. Basic knowledge about waste management and recycling
5. Basic knowledge concerning economy and management

LEARNING OUTCOMES

EU 1 - Student knew core concepts of circular economy, rules, advantages and disadvantages
EU 2 - Student has the specialist knowledge about practical applications of circular economy concepts into management of different waste
EU 3 - Student is able to design of example taking into consideration of relationship between industrial ecology, business, policy and innovation.

COURSE CONTENT

Form of classes - lectures	Hours
Course themes, consumer goods, introduction into the supply chains	2
Intro to life cycle thinking, circular economy and circular systems	4
Review product life cycles and material flows	4
Supply chain vs value chain, supply chain waste	2
Distribution, end-of-first use	2
Producers and customers and extended producer responsibility	2
Flows, stocks, and reservoirs in a CE	2
Examples of CE, strategies for achieving CE	2

Current challenges/barriers with CE	2
Regulatory policy and incentives	2
Circular Economy and economic status who gets involved in making these systems work?	2
Circular economy and capitalism – monetary value drives systems	2
Test	2
Form of classes - tutorials	**Hours**
Waste: What is waste? Where is waste generated? Does waste have an economic value? - discussion panel	1
Discussion: What solutions exist to keep waste out of the landfill?	1
Groups report out on supply chain map	2
Student led Discussion: Why does something become waste? Relationship with customers? Why is this? Price points? Reparability? Identity (defining your personality)?	2
Circular systems thinking. Student led discussion: what should be taught in education to suport circular systems.	2
Role of consumers in CE. Discussion (break into your assignment groups) – What do you want to know about your customers to design products that fit a circular system and what do your customers need to do to participate in a circular system?	2
Product/Design and Development for a circular economy, in class time to work on circular economy assignment	4
Test	1

COURSE STUDY METHODS

1. blackboard, interactive whiteboard
2. multimedia presentation
3. literature from on-line bibliographic databases

METHODS OF ASSESMENT (F - formative; S - summative)

F1. – activity in classes
S1. – test from the lectures
S2. – evaluation created reports from tutorials
S3. – test from tutorials

STUDENT WORKLOAD

Form of activity	Workload (hours)
Participation in lectures	**29 h**
Participation in classes	**14 h**
Laboratory	**- h**
Participation in project classes	**- h**
Participation in seminar	**- h**
Preparation course on e-learning	**- h**
Test	**2 h**
Entrance test for laboratory classes	**- h**
Project's defence	**- h**
Exam	**- h**
Consultation hours	**10 h**

DIRECT TEACHING, hours/ ECTS	**55 h / 1,9 ECTS**
Preparation for tutorials **Preparation for laboratories** **Preparation for projects** **Preparation for seminars** **Preparation for e-learning classes** **Participation in e-learning classes** **Working on project** **Preparation for tests** **Preparation for exam**	**20 h** **- h** **- h** **- h** **- h** **- h** **- h** **10 h** **- h**
SELF-STUDY, hours/ ECTS	**30 h / 1,1 ECTS**
TOTAL (hours)	**∑ 85 h**
TOTAL ECTS	**3 ECTS**

PRIMARY AND SUPPLEMENTARY TEXTBOOKS

Stockholm Resilience Centre, "Planetary Boundaries: A Safe Operating Space for Humanity," 2015.
Rutqvist J., Lacy P. 2015. Waste to wealth: the circular economy advantage
Charter M., 2018. Designing for the circular economy
Hazell J., Benton D., Hill J. 2018 The quide to the Circular Economy. Capturing value and managing material risk.

SUBJECT COORDINATOR (NAME, SURNAME, E-MAIL ADDRESS)

1. Małgorzata Kacprzak, mkacprzak@is.pcz.czest.pl

NAME OF LECTURER (s) (NAME, SURNAME, E-MAIL ADDRESS)

1. Małgorzata Kacprzak, mkacprzak@is.pcz.czest.pl

Learning outcome	In relation to the learning outcomes specified for the field of study	Course objectives	Course content	Course study methods	Methods of assesment
EU 1	**K_W02, K_W06, K_W11,**	**C1-2**	lectures	**1-3**	**S1,**
EU 2	**K_W02, K_W06, K_W11, K_U05, K_U06, K_K02**	**C1-2**	lectures	**1-3**	**S1,**
EU 3	**K_U05, K_U06, K_K02**	**C3**	tutorials	**1-3**	**F1, S2-3**

II. OTHER USEFUL INFORMATION

1. All the information on the class schedule is posted on the student information board and online at: www.is.pcz.pl
2. The information about the consultation hours is provided to students on the first class meeting and posted online at …
3. The information on course completion and grade is provided to students on the first class meeting.

Course title: **Strategies for the International Protection of the Environment**		
Programme: **Intelligent energy for environmental protection**		Code: **4.12**
Type of course: **Module 4, elective, block IIC**	Course level: **II**	Semester: **II**
Form of classes: **lecture, tutorials**	Number of hours per week/~~meeting~~: **2L, 1T**	Credit points: **3**
Education profile: **general academic**		Course language: **English**
Enrolment: **yes**		

SYLLABUS

I. COURSE CHART

COURSE OBJECTIVES

C.1. Familiarize students with the knowledge of basic principles of the strategies for the international protection of the environment.
C.2. Develop competence in understanding issues of environmental protection in the context of globalization.
C.3. Familiarize students with the sustainable development goals.

PRELIMINARY COURSE REQUIREMENTS FOR KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge about the environment
2. Knowledge in the fields of environmental protection

LEARNING OUTCOMES

EU 1 - Student is able to characterize ethical and sociological aspects of the environment protection.
EU 2 - Student knows "clean production" as a philosophy.
EU 3 - Student understand the role of strategies for the international protection of the environment.

COURSE CONTENT

Form of classes - lectures	Hours
Introduction to the lectures.	1
Biosphere and biocenosis.	4
Ozone depletion.	4
Ecological equilibrium.	4
Sustainable development.	4
Environmental protection.	4
Environmental technologies.	2
Clean technologies.	2
Environmental Protection Act.	1

Scientific articles to read.	3
Final conclusion	1
Form of classes - tutorials	**Hours**
Introduction to the tutorials.	1
Globalisation.	1
Sustainable energy supply and climate change.	1
Ethical and sociological aspects of the environment protection.	1
Environmental goods (e.g., climate change, biodiversity, energy and food resources, air, water, etc.) - private, common, public or club goods?	1
"Clean production" as a philosophy and a strategy for the environmental management.	1
The 'clean production' certificate as a form of a voluntary ecological commitment.	1
Stakeholder strength and their priorities in a multilevel governance perspective.	2
Essays presentation and discussion - sustainable environmental strategies and technology needs assessment supporting socio-economic development	4
Final conclusion.	2

COURSE STUDY METHODS

1. Lectures with the use of multimedia presentations.
2. Tutorials.

METHODS OF ASSESMENT (F - formative; S - summative)

F1. – Evaluation of student self preparation for classes
F2. – Evaluation of the work in a group during solving problems
P1. – Colloquium from exercise
P2. – Colloquium from lectures

STUDENT WORKLOAD

Form of activity	Workload (hours)
Participation in lectures	**30 h**
Participation in classes	**15 h**
Laboratory	**-h**
Participation in project classes	**-h**
Participation in seminar	**-h**
Preparation course on e-learning	**-h**
Test	**3 h**
Entrance test for laboratory classes	**-h**
Project's defence	**-h**
Exam	**-h**
Consultation hours	**15 h**
DIRECT TEACHING, hours/ ECTS	**63 h / 2 ECTS**
Preparation for tutorials	**15 h**
Preparation for laboratories	**-h**
Preparation for projects	**-h**
Preparation for seminars	**-h**
Preparation for e-learning classes	**-h**

Participation in e-learning classes **Working on project** **Preparation for tests** **Preparation for exam**	**-h** **-h** **15 h** **-h**
SELF-STUDY, hours/ ECTS	**30 h / 1 ECTS**
TOTAL (hours)	**∑ 93 h**
TOTAL ECTS	**3 ECTS**

PRIMARY AND SUPPLEMENTARY TEXTBOOKS

Renewable Energy in the Context of Sustainable Development, available at http://www.mcc-berlin.net/~creutzig/SRREN_Ch09.pdf
Niedrzwicki W., Zarządzanie środowiskowe, Polskie Wydawnictwo Ekonomiczne, Warszawa
UNDP, Handbook for conducting technology needs assessment for climate change, 2010, available at http://unfccc.int/ttclear/misc_/StaticFiles/gnwoerk_static/TNR_HAB/b87e917d96e94034bd7ec936e9c6a97a/1529e639caec4b53a4945ce009921053.pdf
Łunarski J., Systemy zarządzania środowiskowego, Wyd. Politechnika Rzeszowska, Rzeszów 2006
Websites: Joint Implementation Network, http://www.jiqweb.org/ United Nation Development Programme, http://www.undp.org/content/undp/en/home.html United Nation Framework on Climate Change, http://unfccc.int/2860.php Ministry of the Environment, https://www.mos.gov.pl/en

SUBJECT COORDINATOR (NAME, SURNAME, E-MAIL ADDRESS)

1. Magdalena Zabochnicka-Świątek, mzabochnicka@is.pcz.pl

NAME OF LECTURER (s) (NAME, SURNAME, E-MAIL ADDRESS)

1. Magdalena Zabochnicka-Świątek, mzabochnicka@is.pcz.pl

Learning outcome	In relation to the learning outcomes specified for the field of study	Course objectives	Course content	Course study methods	Methods of assesment
EU 1	**K_W01, K_W02, K_U01, K_U05, K_K01**	**C.1**	Lecture	**1**	**F1**
EU 2	**K_W01, K_W02, K_U01, K_U05, K_K01**	**C.1**	Lecture	**1**	**F1**
EU 3	**K_W01, K_W02, K_U01, K_U05, K_K01**	**C.2**	Lecture/ tutorials	**1,2**	**F1, F2 P1, P2**

II. OTHER USEFUL INFORMATION

1. All the information on the class schedule is posted on the student information board and online at: www.is.pcz.pl
2. The information about the consultation hours is provided to students on the first class meeting.
3. The information on course completion and grade is provided to students on the first class meeting.

Course title: **Phytoremediation by Energetic Plants**		
Programme: **Intelligent Energy for Environmental Protection**		Code: **4.13**
Type of course: **Module 4, elective, block IID**	Course level: **II**	Semester: **II**
Form of classes: **Lecture, Tutorials**	Number of hours per week/meeting: **2L, 2T**	Credit points: **4**
Education profile: **general academic**		Course language: **English**
Enrolment: **yes**		

SYLLABUS

I. COURSE CHART

COURSE OBJECTIVES

C.1. Providing knowledge about phytoremediation techniques like: phytoextraction, phytostabilization, rhizofiltration, phytoaccumulation, phytodegradation, phytovolatilization.

C.2. Providing specialist knowledge about technical requirements for phytoremediation, uptake compounds by plants, control of the processes

C.3. Learning techniques how to conduct phytoremediation (i.e. phytoextraction process), calculate processes parameters, design the process and draw the right conclusions from it.

PRELIMINARY COURSE REQUIREMENTS FOR KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge from chemistry
2. Knowledge from biology

LEARNING OUTCOMES

EU 1 - Has knowledge about phytoremediation techniques like: phytoextraction, phytostabilization, rhizofiltration, phytoaccumulation, phytodegradation, phytovolatilization

EU 2 - Has the specialist knowledge about technical requirements for phytoremediation, uptake compounds by plants, control of the processes

EU 3 - Can model, design and conduct phytoremediation (i.e. phytoextraction) process, calculate processes parameters, design the process and draw the right conclusions from it.

COURSE CONTENT

Form of classes - lectures	Hours
Phytotransformation and control of wastes	4
Green liver model – uptake and metabolism of organic compounds	4
Phytoremediation – successful technology	4

Phytostabilisation and phytoextraction technology	4
Rhizodegradation technology	2
Phytoaccumulation technology	2
Phytodegradation technology	2
Phytovolatilization/Evapotranspiration technology	2
Technical requirements for phytoremediation	2
New technologies in phytoremediation	2
Test	2
Form of classes - tutorials	**Hours**
Modeling and design of phytoremediation	4
Phytoremediation design: - technical requirements - decision tree	4
Project of phytoremediation of degraded terrain (student own work): - selection of technologies depending on the type of contamination - technology design - diagram of the phytoremediation area - calculations of remediation parameters - discussion and conclusions - passing the tutorials project passing	20
Test	2

COURSE STUDY METHODS

1. blackboard, interactive whiteboard
2. multimedia presentation
3. literature from on-line bibliographic databases

METHODS OF ASSESMENT (F - formative; S - summative)

F1. – activity in classes
S1. – test from the lectures
S2. – evaluation created reports from tutorials
S3. – test from tutorials

STUDENT WORKLOAD

Form of activity	Workload (hours)
Participation in lectures	**29 h**
Participation in classes	**28 h**
Laboratory	**- h**
Participation in project classes	**- h**
Participation in seminar	**- h**
Preparation course on e-learning	**- h**
Test	**3 h**
Entrance test for laboratory classes	**- h**
Project's defence	**- h**
Exam	**- h**

Consultation hours	**10 h**
DIRECT TEACHING, hours/ ECTS	**70 h / 2,4 ECTS**
Preparation for tutorials **Preparation for laboratories** **Preparation for projects** **Preparation for seminars** **Preparation for e-learning classes** **Participation in e-learning classes** **Working on project** **Preparation for tests** **Preparation for exam**	**35 h** **- h** **- h** **- h** **- h** **- h** **- h** **10 h** **- h**
SELF-STUDY, hours/ ECTS	**45 h / 1,6 ECTS**
TOTAL (hours)	**∑ 115 h**
TOTAL ECTS	**4 ECTS**

PRIMARY AND SUPPLEMENTARY TEXTBOOKS

McCutcheon, Steven C., and Jerald L. Schnoor. Phytoremediation: transformation and control of contaminants. Vol. 121. John Wiley & Sons, 2004.
Kuhad, Ramesh Chander, and Owen P. Ward. Advances in applied bioremediation. Ed. Ajay Singh. Berlin: Springer-Verlag, 2009.
McIntyre, Terry. "Phytoremediation of heavy metals from soils." *Phytoremediation*. Springer Berlin Heidelberg, 2003. 97-123.
Pilon-Smits, Elizabeth. "Phytoremediation." *Annu. Rev. Plant Biol.* 56 (2005): 15-39.
Fijalkowski, K., Rosikon, K., Grobelak, A., Hutchison, D., & Kacprzak, M. J. (2018). *Modification of properties of energy crops under Polish condition as an effect of sewage sludge application onto degraded soil*. Journal of environmental management, 217, 509-519
Placek-Lapaj, A., Grobelak, A., Fijalkowski, K., Singh, B. R., Almås, Å. R., Kacprzak, M. (2019). *Post–Mining soil as carbon storehouse under polish conditions. Journal of environmental management*, 238, 307-314.
Kacprzak, M. J., Rosikon, K., Fijalkowski, K., Grobelak, A. (2014). *The effect of Trichoderma on heavy metal mobility and uptake by Miscanthus giganteus, Salix sp., Phalaris arundinacea, and Panicum virgatum*. Applied and Environmental Soil Science, 2014.

SUBJECT COORDINATOR (NAME, SURNAME, E-MAIL ADDRESS)

1. Krzysztof Fijałkowski, kfijalkowski@is.pcz.czest.pl

NAME OF LECTURER (s) (NAME, SURNAME, E-MAIL ADDRESS)

1. Krzysztof Fijałkowski, kfijalkowski@is.pcz.czest.pl

Learning outcome	In relation to the learning outcomes specified for the field of study	Course objectives	Course content	Course study methods	Methods of assesment
EU 1	**K_W01, K_K01, K_U05**	**C1-2**	Lecture	**1-3**	**S1,**
EU 2	**K_W01, K_K01**	**C1-2**	Lecture	**1-3**	**S1,**
EU3	**K_K01, K_U01, K_U05**	**C3**	Tutorial	**1-3**	**F1, S2-3**

II. OTHER USEFUL INFORMATION

1. All the information on the class schedule is posted on the student information board and online at: www.is.pcz.pl
2. The information about the consultation hours is provided to students on the first class meeting and posted online at …
3. The information on course completion and grade is provided to students on the first class meeting.

Course title: **Protection of Soil from Environmental Impact**		
Programme: **Intelligent Energy for Environmental Protection**		Code: **4.14**
Type of course: **Module 4, elective, block IID**	Course level: II	Semester: **II**
Form of classes: **Lectures, project**	Number of hours per week/~~meeting~~: **2L, 2P**	Credit points: **4**
Education profile: **general academic**		Course language: **English**
Enrolment: **yes**		

SYLLABUS

I. COURSE CHART

COURSE OBJECTIVES

C.1. Provide the basic knowledge about soil erosion and degradation.
C.2. Provide the basic knowledge about the soil protection.
C.3. To acquire capabilities to choice of soil protection and rehabilitation techniques.
C.4. To acquire capabilities to description of transport of contaminants in the soil.

PRELIMINARY COURSE REQUIREMENTS FOR KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Fundamentals of soil science, chemistry, biology, ecology, geology and geomorphology.
2. The basic knowledge in sources and types of contaminants in the environment.
3. Capability of using source literature.
4. Capability of software operation
5. Capability of individual work and collaboration in a group.

LEARNING OUTCOMES

EU 4 - Knowledge on soil erosion and degradation
EU 5 - Knowledge on methods and necessity of soil protection
EU 6 - Ability to choice of soil protection and rehabilitation techniques
EU 7 - Ability to description of transport of contaminants in the soil

COURSE CONTENT

Form of classes - lectures	Hours
Introduction to the subject. Genesis and functions of soils	2
Soil morphology. The profile of mineral and organic soil. Genetic and diagnostic soil horizons. The soil taxonomy	4
The soil texture and its influence on the water drainage, soil aeration, water holding capacity, and susceptibility to erosion	2

Physical properties of soils. Methods of determination of the soil colour, density and porosity	2
The methods of soil moisture determination. The water potential as the measure of potential energy in water. The osmotic (solute) potential	2
The soil chemistry. The detection, occurrence, and role of macroelements and microelements	2
The soil sorption (adsorption, desorption). The sorption complex, exchangeable sorption, sum of exchangeable cations	4
The soil fertility. The exchange of matter and energy in soils	2
The soil erosion and degradation	2
Transport and fate of contaminants in soils	2
The soil protection and remediation	2
The storage of energy in the soil	2
The colloquium	2
Form of classes - project	**Hours**
Organizational class. Introduction to the projects	2
The project of the prediction of transport and fate of contaminants in the soil	8
Project of the measures for preventing the soil erosion caused by surface runoff	8
The project of the remediation of the contaminated soil and groundwater	10
The evaluation of the projects	2

COURSE STUDY METHODS

1. multimedia presentations
2. literature
3. computer softwares

METHODS OF ASSESSMENT (F - formative; S - summative)

F1. – activity in project classes
S1. – colloquium
S2. – assessment of projects

STUDENT WORKLOAD

Form of activity	Workload (hours)
Participation in lectures	**30 h**
Participation in classes	**-h**
Laboratory	**-h**
Participation in project classes	**30 h**
Participation in seminar	**-h**
Preparation course on e-learning	**-h**
Test	**2 h**
Entrance test for laboratory classes	**-h**
Project's defence	**1 h**
Exam	**-h**
Consultation hours	**4 h**
DIRECT TEACHING, hours/ ECTS	**67 h / 2,63 ECTS**

Preparation for tutorials **Preparation for laboratories** **Preparation for projects** **Preparation for seminars** **Preparation for e-learning classes** **Participation in e-learning classes** **Working on project** **Preparation for tests** **Preparation for exam**	**-h** **-h** **10 h** **-h** **-h** **-h** **15 h** **10 h** **-h**
SELF-STUDY, hours/ ECTS	**35 h / 1,37 ECTS**
TOTAL (hours)	**∑ 102 h**
TOTAL ECTS	**4 ECTS**

PRIMARY AND SUPPLEMENTARY TEXTBOOKS

Brady, N.C., Weil, R.R., Elements of the Nature and Properties of Soils (3rd Edition), Pearson Education inc., **2009**
Brady, N.C., Weil, R.R., The Nature and Properties of Soils (14th Edition), Prentice-Hall, **2007**
Sumner, M.E., Handbook of Soil Science. CRC Press LLC, 2000
Yerima, B.P.K, van Ranst, E., Introduction to Soil Science: Soils of the Tropics. Trafford Publishing 2005
Chesworth, W., Encyclopedia of Soil Science. Springer Science & Business Media, 2008
Millar, C.E., Turk, L.M., Fundamentals of Soil Science. Biotech Books, 2002
Chiang, W.H., Kinzelbach, W., Processing Modflow. A simulation system for modelling groundwater flow and pollution. User Guide for computer program Processing Modflow for Windows (PMWIN). http://www.pmwin.net/programs/prevpm/pm4/doc/pmwin41.pdf
Nonner, J.C., Introduction to hydrogeology. Taylor & Francis Group plc, London, UK 2006
Sanders, L.L., A manual of field hydrogeology. Prentice-Hall, Inc. 1998
Baran, S., Turski, R., Degradacja, ochrona i rekultywacja gleb. Wyd. AR, Lublin 1996
Dobrzański, B., Zawadzki, S., Gleboznawstwo. Wyd. IV, PWRiL, Warszawa 1999
Mrowiec, M., Ociepa, E., Malmur, R., Deska, I., Sustainable Water Management in Cities under Climate Changes. Problemy Ekorozwoju. 2018, 13(1), 133-138
Deska, I., Mrowiec, M., Ociepa, E., Łacisz, K., Investigation of the influence of the hydrogel amendment on the retention capacities of green roofs. Ecological Chemistry and Engineering S, 2018, 25(3), 373-382
Deska, I., Łacisz, K., The possibility of the light non-aqueous phase liquids migration in the layered porous medium. Ecological Chemistry and Engineering A, 2016, 25(3), 373-382

SUBJECT COORDINATOR (NAME, SURNAME, E-MAIL ADDRESS)

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NAME OF LECTURER (s) (NAME, SURNAME, E-MAIL ADDRESS)

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Learning outcome	In relation to the learning outcomes specified for the field of study	Course objectives	Course content	Course study methods	Methods of assesment
EU 1	**K_W01, K_W10, K_U01, K_U04, K_U05, K_K01**	**C.1.**	Lecture	**1**	**S1.**
EU 2	**K_W01, K_W10, K_U01, K_U04, K_U05, K_K01**	**C.2.**	Lecture	**1**	**S1.**
EU 3	**K_W01, K_W10, K_U01, K_U04, K_U05, K_K01**	**C.3.**	Lecture / Project	**1, 2, 3**	**F1., S1., S2.**
EU 4	**K_W01, K_W10, K_U01, K_U04, K_U05, K_K01**	**C.4.**	Lecture / Project	**1, 2, 3**	**F1., S1., S2.**

II. OTHER USEFUL INFORMATION

1. All the information on the class schedule is posted on the student information board and online at: www.is.pcz.pl
2. The information about the consultation hours is provided to students on the first class meeting and posted online at …
3. The information on course completion and grade is provided to students on the first class meeting.

Course title: **Diploma Seminar**		
Programme: **Intelligent energy for environmental protection**		Code: **5.2**
Type of course:	Course level: **II**	Semester: **III**
Form of classes: **seminar**	Number of hours per week/meeting: **2S**	Credit points: **2**
Education profile: **generale academic**		Course language: **English**
Enrolment: **no**		

SYLLABUS

I. COURSE CHART

COURSE OBJECTIVES

C.1. Providing knowledge on substantive and formal preparation of engineering works and presentation of research results.

C.2. Acquisition of the ability to prepare and self-present, as well as to participate, discuss and evaluate the presentation of other speakers.

PRELIMINARY COURSE REQUIREMENTS FOR KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge in the field of energy and environmental engineering obtained during the studies.
2. Ability for independent study of the literature and technical papers.

LEARNING OUTCOMES

EU 1 - Able to compile and analyze information obtained from various sources, as well as present the results it in a clear way and formulate conclusions.

EU 2 - Can prepare and give a presentation in the field of study with the use of audiovisual means.

EU 3 - Can take an active part in the substantive discussion.

EU 4 - Understands the need to distribute engineering knowledge, also with the use of mass media.

COURSE CONTENT

Form of classes – seminar	Hours
The purpose and goals of the writing of engineering works, reports and/or thesis. Structure and logical organization of work chapters (subject, introduction, literature review, scope of work, research methodology, analysis of results, conclusions, proposals for further research). Proper presentation of tables, equations, drawings. References to literature.	4
The most common formal errors. Elements necessary and unnecessary in the diploma thesis. The correct use of thematic literature. Ethics of writing: plagiarism. Confidentiality.	2

Principles of the preparation and presentation of papers taking into account the type of the recipient and his expectations. The structure, content and presentation method, time and detail levels of the presentation, the need to emphasize and highlight the most important issues and conclusions. Attractiveness of the presentation and contact with the auditorium, articulation and gesturing. The essence and method of asking questions correctly, answering questions and participating in a substantive discussion.	4
Individual presentations of the students: literature survey, work plan, summary of the thesis. Discussion, indication of errors and omissions and evaluation of the presentation by the listeners.	18
Individual discussion and credit	2

COURSE STUDY METHODS

1. Seminar activities with the use of multimedia presentations.
2. Works in the library and survey and selection of the literature. Multimedia presentations prepared by the students. Questions and discussion.

METHODS OF ASSESMENT (F - formative; S - summative)

F1. – assessment self-preparation for classes
F2. – assessment of student's activity during the classes
S1. – verification of student's knowledge (presentation and discussion).

STUDENT WORKLOAD

Form of activity	Workload (hours)
Participation at lectures	**- h**
Participation at classes	**- h**
Laboratory	**- h**
Participation at project classes	**- h**
Participation at seminar	**30 h**
Preparation course on e-learning	**- h**
Test	**- h**
Entrance test for laboratory classes	**- h**
Project's defence	**2 h**
Exam	**- h**
Consultation hours	**3 h**
DIRECT TEACHING, hours/ ECTS	**35 h / 1,3 ECTS**
Preparation for tutorials	**- h**
Preparation for laboratories	**- h**
Preparation for projects	**- h**
Preparation for seminars	**20 h**
Preparation for e-learning classes	**- h**
Participation in e-learning classes	**- h**
Working on project	**- h**
Preparation for tests	**- h**
Preparation for exam	**- h**
SELF-STUDY, hours/ ECTS	**20 h / 0,7 ECTS**

TOTAL (hours)	**∑ 55 h**
TOTAL ECTS	**2 ECTS**

PRIMARY AND SUPPLEMENTARY TEXTBOOKS

Bolton R., People Skills: How to Assert Yourself, Listen to Others, and Resolve Conflicts, Simon & Schuster Inc., First Touchstone Ed., 1986, ISBN-13: 978-0671622480
Web informations on how to talk to other people, can be found e.g. at: http://www.peopleskillsdecoded.com/how-to-talk-to-people/

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Learning outcome	In relation to the learning outcomes specified for the field of study	Course objectives	Course content	Course study methods	Methods of assesment
EU 1-4	**K_W06, K_W07, K_W08, K_U04, K_U05, K_U11, K_U12, K_K03, K_K04**	**C.1, C.2**	Seminar	**1, 2**	**F1, F2, S1**

II. OTHER USEFUL INFORMATION

1. All the information on the class schedule is posted on the student information board and online at: www.is.pcz.pl
2. The information about the consultation hours is provided to students during the first meeting and posted online at the Faculty web page.
3. The information on the rules to complete the course is provided to students during the first meeting.