Załącznik nr 6 do ZW 121/2020

FACULTY OF MECHANICAL AND POWER ENGINEERING

SUBJECT CARD

Name of subject in Polish:	Produkcja energii z biomasy
Name of subject in English:	Biomass in energy production
Main field of study (if applicable):	Power Engineering
Specialization (if applicable):	Renewable Sources of Energy
Profile:	academic
Level and form of studies:	2nd level, full-time
Kind of subject:	optional/specialization
Subject code:	W09ENG-SM0044
Group of courses:	NO

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30			15	
Number of hours of total student workload (CNPS)	60			30	
Form of crediting	crediting with grade			crediting with grade	
For group of courses mark final course with (X)					
Number of ECTS points	2			1	
including number of ECTS points for practical (P) classes	0			1	
including number of ECTS points for direct teacher-student contact (BU) classes	1			0.75	

*delete as applicable

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge, skills and other competences from the scope of thermodynamics, fuel characterization and combustion, chemistry and boilers.

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SUBJECT OBJECTIVES

C1 Familiarize students with the classification and characteristics of biomass as a fuel, processes of biomass preparation and biomass processing, energy use technologies.

C2 Creating a student application skills based on the theoretical knowledge for the design a biomass utilisation processes, especially as a biomass solid fuel.

SUBJECT LEARNING OUTCOMES

relating to knowledge:

PEU_W01 - Describe the general classification of biomass and characterization of their properties and analytical methods for their determination.

PEU_W02 - Characterize the thermal and mechanical pretreatment of biomass, determine main problems occurs in the process of combustion and co-firing in power boilers.

PEU_W03 - Present and characterize the various technologies and devices which use the biomass for energy production.

relating to skills:

PEU_U01 - Perform basic calculations of the composition of combustion gases from biomass, calorific value depending on the composition of the biomass or blends.

PEU_U02 - Selection of coefficients necessary to perform calculations of biomass combustion boiler and design a conceptual project for biomass combustion.
PEU_U03 - Perform design calculations for the biomass thermal valorisation process.

PROGRAM CONTENT

Lectures		Number of hours
Lec 1	State of the art of energy production from biomass fuel. The potential, types, basic definition and physicochemical properties of biomass.	2
Lec 2	Analytical methods of biomass characterization as a fuel.	2
Lec 3	Fuel production from biomass formed by the mechanical pretreatment.	2
Lec 4	Fuel production from biomass formed by the thermal pretreatment.	2
Lec 5-6	Combustion of biomass and high rank fuel production from biomass by thermo-chemical processing (biogas, syngas).	4
Lec 7	Small, medium and large capacity boilers, types of furnaces using biomass.	2
Lec 8	Direct co-firing technique. Advantages and disadvantages of biomass combustion in power PC and CFB boilers.	2
Lec 9	Operating problems, emission monitoring, risk of corrosion and deposits formation during biomass combustion.	2
Lec 10	Indirect co-firing technique for biomass power production.	2
Lec 11	Technologies using waste incineration for energy production.	2
Lec 12	Integrated advanced systems of power production from biomass (gasification of biomass, gas purification system, CO_2 capture)	2
Lec 13	Transport system of biomass and its storage.	2
Lec 14	Example of biomass power plant – case study.	2
Lec 15	Final test.	2
	Total hours	30

Project		Number of hours
Proj 1	Use the equations of biomass composition and LHV for different biomass and its blend.	2
Proj 2	Balance calculation of biomass combustion in selected condition.	2
Proj 3	A comparative analysis of the slagging index for biomass and its blend.	2
Proj 4	Design calculations of biomass boiler and the conceptual design of the biomass furnace, calculation of combustion temperature and efficiency.	4
Proj 5	Design calculation of thermal biomass valorisation process for selected technology.	4
Proj 6	Evaluation of the project	1
	Total hours	15

TEACHING TOOLS USED

N1. Traditional lecture with the use of multimedia presentation. Student self-study – preparation for the final test. Discussion.
N2. Design exercises with the use of equations and additional materials (books, catalogues, charts, etc.) performed by the students in small group or individually during classes (varied). Student self-study – project tasks calculation and design. Presentation of the final project.
N3. Office hours.

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
P (lecture)	PEU_W01- PEU_W03	Final tests
P (project)	PEU_U01- PEU_U03	Project evaluation

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] The Handbook of Biomass Combustion and Co-firing, Koppejan Jaap, Sjaak van Loo, Routledge, 2012.
[2] Biomass Supply Chains for Bioenergy and Biorefining, Holm-Nielsen, Jens Bo; Ehimen, Ehiaze Augustine, Elsevier, 2016.
[3] Biomass Combustion Science, Technology and Engineering, Lasse Rosendahl , Woodhead , 2013.
[4] Technologies for converting biomass to useful energy : combustion, gasification, pyrolysis, torrefaction and fermentation, Erik Dahlquist, Sustainable Energy Developments 2164-0645 vol. 4, Boca Raton etc. : CRC Press/Taylor & Francis Group, 2013.
[5] Boilers and Burners, Basu, Springer New York, 2000.

SECONDARY LITERATURE:

[1] Biomass Conversion Processes for Energy and Fuels, Samir S. Zaborsky, Oskar R. Sofer, Springer US, 1981
[2] Biomass Combustion, Dictionary of Energy, Elsevier Science & Technology, 2014.

SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)

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