AGH UNIVERSITY OF SCIENCE AND TECHNOLOGY

Module name: Biomass in Energy Applications

Academic year: 2013/2014 Code: STC-2-114-CF-s ECTS credits: 3

Faculty of: Energy and Fuels

Field of study: Chemical Technology Specialty: Clean Fossil and Alternative Fuels Energy

Study level: Second-cycle studies Form and type of study: Full-time studies

Lecture language: English Profile of education: Academic (A) Semester: 1

Course homepage: —

Responsible teacher: prof. nadzw. dr hab. inż. Filipowicz Mariusz (filipow@agh.edu.pl)

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Description of learning outcomes for module

MLO code	Student after module completion has the knowledge/ knows how to/is able to	Connections with FLO	Method of learning outcomes verification (form of completion)
Social competence			
M_K001	Student is aware of his/her responsibility for tasks realized by a team	TC2A_K04	Completion of laboratory classes, Involvement in teamwork
M_K002	Student is able to think creatively	TC2A_K06	Activity during classes, Participation in a discussion
Skills			
M_U001	Student is able to search, evaluate and convert data from scientific literature and other selected sources	TC2A_U01	Oral answer, Report, Project
Knowledge			
M_W001	Student hs knowledge of devices, grids and energy systems.	TC2A_W17	Oral answer, Project
M_W002	Student knows advanced methods of renewable energy sources use, storage and cooperation with fuel and energy systems	TC2A_W09	Activity during classes, Oral answer, Project

FLO matrix in relation to forms of classes

MLO code	Student after module completion has the knowledge/ knows how to/is able to	Form of classes										
		Lectures	Auditorium classes	Laboratory classes	Project classes	Conversation seminar	Seminar classes	Practical classes	Others	Fieldwork classes	Workshops	E-learning
Social competence												
M_K001	Student is aware of his/her responsibility for tasks realized by a team	-	-	+	+	-	-	-	-	-	-	-
M_K002	Student is able to think creatively	+	-	+	+	-	-	-	-	-	-	-
Skills												
M_U001	Student is able to search, evaluate and convert data from scientific literature and other selected sources	-	-	+	+	-	-	-	-	-	-	-
Knowledge												
M_W001	Student hs knowledge of devices, grids and energy systems.	+	-	+	+	-	-	-	-	-	-	-
M_W002	Student knows advanced methods of renewable energy sources use, storage and cooperation with fuel and energy systems	+	-	+	+	-	-	-	-	-	-	-

Module content

Lectures

1. Problems of combustion and co-combustion of different biomass types (wood, pellets, straw, sewage sludge and other)
2. Devices dedicated to biomass combustion (boilers, stoves, furnaces and other) – design, exploitation, construction issues..
3. Co-combustion of biomass fuels (straw, wood, pellets, etc)
4. The emission of pollutants and particulate matter from biomass boilers – generation, measurement, reduction methods
5. The control and optimization of combustion process
6. The exploitation problems of biomass boilers (corrosion, ash and other)
7. The analysis of faults and breakdowns during the biomass boilers exploitation

Classes include also a study visit to a company –a manufacturer of biomass boilers, with the presentation of technological process and discussion with different employeesfrom different departments of the company

Laboratory classes

1. Determination of temperature distribution in combustion chamber of the biomass

boiler
2. Analysis of gas exhaust resulting from combustion process
3. Measurement of particulate matter concentration in flue gases
4. Measurement of boiler thermal power during combustion of biomass with different parameters
5. Measurement of heat accumulation
6. Monitoring and control of biomass combustion by application of different control algorithms
7. Studies of operation of selected components (exchangers, heaters, radiators) and simple ORC unit.

Project classes

1. Analysis of combustion reactions
2. Calculations of efficiency and losses
3. Elements of numerical modeling of parts of energy devices based on biomass
4. Heating systems based on biomass

Method of calculating the final grade

Evaluations of laboratory exercises (L) are calculated on the basis of the points from the reports and activities in the laboratory, under the Regulation of University Studies. Evaluations of project classes (P) are calculated on the basis of grades from projects prepared by the groups of students and score from test. Evaluation of the lecture (Z) is determined on the basis of the results of the first completion test in accordance with the Regulations of University Studies.
Final rating (FR) is calculated as a weighted average of these ratings
$FR = 0.3 \cdot w \cdot Z + 0.3 \cdot w \cdot P + 0,4 \cdot w \cdot L$
w = 1 for the I term, w = 0.9 for the first retake, w = 0.8 for second retake

Prerequisites and additional requirements

General knowledge of physics, mathematics and chemistry. Ability to perform laboratory measurements, general knowledge of measurement techniques and basics of data processing.

Recommended literature and teaching resources

1. The Handbook of Biomass Combustion and Co-firing, Edited by Sjaak van Loo and Jaap Koppejan, Eartscan, 2008,ISBN: 978-1-84407-249-1,
2. Donald L. Klass, Biomass for renewable energy, fuels and chemicals, Academic Press
3. Scientifics papers from journals Biomass and Bioenergy, Renewable Energy and others

Scientific publications of module course instructors related to the topic of the module

Additional scientific publications not specified

Additional information

None

Student workload (ECTS credits balance)

Student activity form	Student workload
Participation in lectures	10 h
Participation in laboratory classes	20 h
Participation in project classes	15 h
Preparation for classes	10 h
Completion of a project	15 h
Realization of independently performed tasks	20 h
Summary student workload	90 h
Module ECTS credits	3 ECTS