Course Syllabus

I. General Information

Course name	Bioenergy technologies
Programme	Biotechnology
Level of studies (BA, BSc, MA, MSc, long-cycle MA)	MSc
Form of studies (full-time, part-time)	part-time
Discipline	Biological sciences
Language of instruction	English

Course coordinator/person responsible	dr hab. Anna Szafranek-Nakonieczna

Type of class *(use only the types mentioned below)*	Number of teaching hours	Semester	ECTS Points
lecture	15	I	5
tutorial			
classes	26	I	
laboratory classes			
workshops			
seminar			
introductory seminar			
foreign language classes			
practical placement			
field work			
diploma laboratory			
translation classes			
study visit	4	I	

Course pre-requisites	Basic knowledge of chemistry, biochemistry, physicochemical methods, analytical methods for biotechnology

II. Course Objectives

To familiarize students with the forms, resources and sources of world's renewable energy and the contribution of bioenergy in in international and country energy structure.	
Acquainting with the basic laboratory analyzes and technologies used in bioenergetics.	
The acquisition of skills used for evaluation of renewable energy usefulness.	
Presentation of technologies enabling obtaining electricity and thermal energy from biomass.	

III. Course learning outcomes with reference to programme learning outcomes

Symbol	Description of course learning outcome	Reference to programme learning outcome
KNOWLEDGE		
W_01	The student knows the terminology associated with the subject, defines the basic phenomena and processes in the field of bioenergy technologies. Has a knowledge about the resources and sources of renewable energy in the energy structure of country and the world.	K_W01
W_02	The student has knowledge of biochemistry, microbiology and biology used in biotechnological processes leading to energy acquisition.	K_W02
W_03	The student has the necessary knowledge in the field of biotechnology solutions for energy and environmental protection as well as the possibilities of their application.	K_W03
W_04	The student knows the basic laboratory techniques used in bioenergy technologies and has knowledge of the principles of research planning with their use.	K_W05
W_05	The student possess the knowledge about health and safety procedures in the didactic laboratory and a laboratory dealing with research on methods of obtaining bioenergy.	K_W07
SKILLS		
U_01	The student performs laboratory analyzes in the field of obtaining bioenergy using the living organisms and biomass.	K_U01
U_02	The student has the skills about evaluation renewable energy usefulness, estimates net photosynthesis efficiency from various ecosystems, biomass production; as well as biogas production in the process of anaerobic fermentation.	K_U07
U_03	The student is aware of the usefulness of acquired skills in the field of biotechnological processes in power engineering, environmental protection, agriculture	K_U11
U_04	The student is able to assess the environmental impact of the use of innovative techniques in the field of obtaining bioenergy and growing bioenergy plants.	K_U12
U_05	The student shows responsibility and is aware of the need to reliably assess the risks resulting from the applied research techniques and create conditions for safe work in the laboratory.	K_U15
U_06	The student demonstrates the ability to analyze information (from literature, electronic sources) concerning innovative techniques in the area of acquiring bioenergy (from algae, microorganisms) with their environmental consequences. Understands the need to systematically deepen your knowledge.	K_U16
SOCIAL COMPETENCIES		
K_01	The student is aware of the value and the need to develop technologies for obtaining bioenergy in the context of caring for the state of the environment and ensuring energy security.	K_K01

K_02	Is able to realistically assess the risks resulting from the applied research techniques, notices the necessity to create conditions for safe work in the laboratory. He/she demonstrates care for laboratory equipment entrusted to him/her. Is ready to consult experts.	K_K03

IV. Course Content

Lecture: Biomass, definitions, formation. Acquisition and use of biomass energy. Types of energy crops and their cultivation. Agglomeration of biomass. Wood and straw as biofuels. Thermal transformation of biomass - combustion systems, co-combustion, pyrolysis. Liquid biofuels, acquisition and use. Hydrogen, current and future use of hydrogen.
Laboratory classes: Introduction, health and safety regulations, general requirements.
Energy sourcing by a gradient of electrochemical potential. Photochemical energy creation by microorganisms and sources of light energy. Estimation of photosynthetical efficiency by biomass growing. Quality factors of energetical potential of plants biomass. Thermal energy of composting processes. Evaluation of the effectiveness and stage of the composting process based on microbiological analyzes. Parameters of biogas production.
Study visit: A visit to the KOM-EKO (Waste Management Plant in Lublin). History of waste management. The purpose of waste segregation. Materials indicated for recycling. Fuel from bio-waste and its use. Mechanical and biological waste treatment. Composting.

V. Didactic methods used and forms of assessment of learning outcomes

Symbol	Didactic methods *(choose from the list)*	Forms of assessment *(choose from the list)*	Documentation type *(choose from the list)*
KNOWLEDGE			
W_01	Conventional lecture Laboratory analysis	Written exam Report Written test / test	Evaluated exam Report printout / Report file Completed and evaluated test
W_02	Conventional lecture Laboratory analysis Praca pod kierunkiem	Written exam Report Written test / test	Evaluated exam Report printout / Report file Completed and evaluated test
W_03	Conventional lecture Laboratory analysis Study visit	Written exam Observation Report	Evaluated exam Rating card / Report from observation Report printout / Report file
W_04	Laboratory analysis	Observation Report	Rating card / Report from observation Report printout / Report file
W_05	Laboratory analysis	Observation	Rating card / Report from observation

SKILLS			
U_01	Laboratory classes	Observation Report	Rating card / Report from observation Report printout / Report file
U_02	Laboratory classes	Observation Report	Rating card / Report from observation Report printout / Report file
U_03	Laboratory classes	Observation	Rating card / Report from observation
U_04	Laboratory classes	Observation Report	Rating card / Report from observation Report printout / Report file
U_05	Laboratory classes	Observation Report	Rating card / Report from observation Report printout / Report file
U_06	Laboratory classes	Observation Report	Rating card / Report from observation Report printout / Report file
SOCIAL COMPETENCIES			
K_01	Laboratory classes Study visit	Observation Report	Rating card / Report from observation Report printout / Report file
K_02	Laboratory classes	Observation	Rating card / Report from observation

VI. Grading criteria, weighting factors.....

Lecture: Written exam in the form of test - 90%, participation in the lectures - 10%
Classes: Tests (4) – 90%, preparation of report and timeliness in completing them – 10%,
Study visit: Presence at the classes – 50%, preparation of report – 50%.

Mark	**Evaluation criteria**	
very good (5)	the student realizes the assumed learning outcomes at a very good level	the student demonstrates knowledge of the education content at the level of 91-100%
overgood (4.5)	the student accomplishes the assumed learning outcomes an over good level	the student demonstrates knowledge of the education content at the level of 86-90 %
good(4)	the student accomplishes the assumed learning outcomes at a good level	the student demonstrates knowledge of the education content at the level of 71-85%

quite good(3.5)	the student accomplishes the assumed learning outcomes at a quite good level	the student demonstrates knowledge of the education content at the level of 66-70%
sufficient (3)	the student accomplishes the assumed learning outcomes at a sufficient level	the student demonstrates knowledge of the education content at the level of 51-65%
insufficient (2)	the student accomplishes the assumed learning outcomes at an insufficient level	the student demonstrates knowledge of the education content below the level of 51%

VII. Student workload

Form of activity	Number of hours
Number of contact hours (with the teacher)	45
Number of hours of individual student work	80

VIII. Literature

Basic literature
Borowitzka M.A., Moheimani N.R. (ed.) Algae for Biofuels and Energy, Springer, 2013. Marco Aurélio dos Santos Bernardes (ed.) Biofuel production – recent developments and prospects. InTech, 2011. Jacob-Lopes E., Queiroz Zepka L.(ed.), Frontiers in Bioenergy and Biofuels, InTech, 2017
Additional literature
Bauen A., Berndes G., Junginger M., Londo M., Vuille F., Bioenergy – a Sustainable and Reliable Energy Source. A review of status and prospects. IEA Bioenergy, 2009. Kalt G., Kranzl L., Haas R., Bioenergy in Central Europe – recent developments, international biofuel trade and future prospects, In: Energy Resources: Developmentitor: Enner Herenio de Alcantara (ed.), Nova Science Publishers, Inc., 2011.