DOCTORAL SCHOOL OF WROCŁAW UNIVERSITY OF SCIENCE AND TECHNOLOGY

SUPERVISOR DECLARING/CONDUCTING COURSE: Izabela Pawlaczyk-Graja
DEPARTMENT: Chemical Department
SCIENTIFIC DISCIPLINE: Chemical Engineering

COURSE CARD

Course name in Polish: Biorafinerie w zrównoważonym rozwoju
Course name in English: Biorefineries in Sustainable Development
Course language: Polish
University-wide general course type*: Yes/ No
~~**1) basic course**~~
2) specialist course
~~**3) seminar**~~
~~**4) humanistic course**~~
~~**5) language**~~

Subject code: CIQ100102W

	Lecture	Foreign language course	Seminar	Mixed forms
Number of hours of organized classes in university (ZZU)	30			
Grading	Exam	Exam	Oral presentation	Exam, inspection, evaluation classes
Number of ECTS points	**0**			

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of chemical processes.
2. General knowledge in the field of organic chemistry and chemical engineering.

\

COURSE OBJECTIVES

C1 To acquaint PhD students with the principles of economic analysis and appropriate selection of processes unit used in technologies for processing renewable raw materials.
C2 Develop the ability to draw conclusions and synthetic thinking in terms of selection of unit processes in refineries, taking into account sustainable principles development.
C3 To acquaint PhD students with the latest achievements in the field of biomass utilization for the production of chemicals and modern technology products.

PROGRAM CONTENTS

Form of classes – lecture (Lec)		Number of hours
Lec1	Biorefinery concept. Economic challenges.	2
Lec2	Methodologies for the economic analysis of biorefineries.	2
Lec3	Basic principles of biorefinery design including heat integration.	2
Lec4	Life cycle analysis (LCA) in biorefineries.	2
Lec5	Analysis of the biorefinery impact on the environment and society. Monitoring of indicators.	2
Lec6	Unit processes in biorefineries - reaction strategies.	2
Lec7	Unit processes in biorefineries - bioreactors.	2
Lec8	Unit processes in biorefineries - bioproduct separation techniques.	2
Lec9	Methods for optimizing technological processes.	2
Lec10	Renewable raw materials for biorefining processes.	2
Lec11	Biomass processing technologies - lignocellulose biorefineries.	2
Lec12	Biomass processing technologies - cereal biorefineries.	2
Lec13	Biomass processing technologies - biooils.	2
Lec14	Biomass processing technologies - algae.	2
Lec15	Biomass processing technologies - case studies including sustainable development rules.	2
	Total hours:	**30**

TEACHING TOOLS USED

N1. informative lecture with elements of a problem lecture.
N2. multimedia presentation (projector)

ACHIEVED SUBJECT LEARNING OUTCOMES

Type of learning outcome	Code of learning outcome	Assessment of learning outcome
Knowledge	**P8U_W**	exam
Knowledge	**P8S_WG**	exam
Skills	**P8U_U**	exam, participation in the discussion
Skills	**P8S_UW**	exam, participation in the discussion
Social competence	**P8U_K**	participation in the discussion

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Burczyk B., Biomasa. Surowiec do syntez chemicznych i produkcji paliw. Wyd. 2, Wydawnictwo Politechniki Wrocławskiej, Wrocław, 2019.
[2] Sadhukhan J., Ng K.S., Hernandez E.M., Biorefineries and Chemical Processes Design, Integration and Sustainability Analysis. John Wiley & Sons, Ltd., 2014.
[3] Rabaçal M., Ferreira A.F., Silva C.A.M., Costa M., Biorefineries. Targeting Energy, High Value Products and Waste Valorisation. Springer International Publishing AG, 2017.
[4] Bastidas-Oyanedel J.-R., Schmidt J.E., Biorefinery. Integrated Sustainable Processes for Biomass Conversion to Biomaterials, Biofuels, and Fertilizers. Springer Nature Switzerland AG, 2019.

SECONDARY LITERATURE:

[5] Burczyk B.: Zielona chemia. Zarys. Wydawnictwo Politechniki Wrocławskiej, Wrocław, 2006.
[6] Bergeron C., Carrier D. J., Ramaswamy S.: Boirefinery Co-products. Phytochemicals, Primary Metabolites and Value-Added Biomass Processing. John Wiley & Sons, Ltd., 2012.
[7] Kamm B., Gruber P. R., Kamm M.: Biorefineries – Industrial Processes and Product. WILEY-VCH Verlag GmbH & Co., 2006.
[8] Figoli A., Cassano A., Basile A., Membrane Technologies for Biorefining. Woodhead Publishing, Elsevier Ltd., 2016.

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

Izabela Pawlaczyk-Graja, Eng PhD DSc Assoc. Prof.
izabela.pawlaczyk@pwr.edu.pl