DOCTORAL SCHOOL OF WROCŁAW UNIVERSITY OF SCIENCE AND TECHNOLOGY

SUPERVISOR/TEAM/ DECLARING/CONDUCTING COURSE: Dorota.Jermakowicz-Bartkowiak, Piotr Cyganowski
DEPARTMENT: Chemical Department
SCIENTIFIC DISCIPLINE: Chemical Engineering

COURSE CARD

Course name in Polish: Technologie separacyjne w ochronie środowiska
Course name in English: Separation methods for environmental protection
Course language Polish / ~~English*~~
The course is intended for all PhD students: YES / NO
~~1) BASIC COURSE~~
2) SPECIALIST COURSE
~~3) SEMINAR~~
~~4) HUMANISTIC COURSE~~
~~5) LANGUAGE~~

Subject code: CIQ100100W

* delete as applicable

	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 general chemistry
2. Knowledge of subjects in the field of environmental protection
3. Basic knowledge of chemical technology, unit processes and chemical engineering

COURSE OBJECTIVES

C1 Introducting the student to the problems of environmental pollution from different streams
C2 Introduction the student to the separation techniques and the need to apply the latest separation technologies to protect the environment
C3. Teaching a student how to assemble a specialized test stand
C4. Providing information on the economic aspect of the recovery of strategic raw materials from industrial wastewater and from waste electrical and electronic equipment (WEEE)

PROGRAM CONTENTS

Form of classes – lecture (Lec)		Number of hours
Lec1	The main sources of environmental pollution	2
Lec2	Industrial and municipal sewage management, technologies for mine water treatment and their purification	2
Lec3	Drinking water purification methods	2
Lec4	Polymer sorbents for environmental protection	2
Lec5	The use of sorption techniques in removing microorganisms and organic pollutants from the aquatic environment	2
Lec6	The use of various hydrometallurgical methods in ore processing and separation of waste and scrap materials (WEEE)	2
Lec7	Polymer sorbents in wastewater treatment	2
Lec8	Ion exchange resins in ballast metal separation	2
Lec9	Ion exchange resins in the recovery of precious metals	2
Lec10	Polymer catalysts in the control of environmental hazards	2
	Total hours:	**20**

Form of classes – mixed forms (mix)		Number of hours
Mix1	Laboratory classes, introduction, preparation of reagents	2
Mix2	Preparation of an ion exchanger resin	2
Mix3	Characterization of the ion exchange resin	2
MIX4	Precious metal sorption on the ion exchange resin	2
Mix5	Precious metal desorption, discussion on the results	2
	Total hours	**10**

TEACHING TOOLS USED

N1. Lecture + multimedia presentation
N2. Participation in demonstration in laboratory classes, performing the indicated experiments
N3. Discussion panel, performance of exercises, joint elaboration of results

ACHIEVED SUBJECT LEARNING OUTCOMES		
Type of learning outcome	Code of learning outcome	Assessment of learning outcome
Knowledge	**P8U_W**	competently quotes other authors in published and prepared for publication scientific publications, in reviewed materials from international scientific conferences, in book editions preceding the preparation of the doctoral dissertation
Knowledge	**P8S_WG**	has advanced level knowledge of major subjects in a given discipline or interdisciplinary subjects

Skills	**P8U_U**	can classify scientific publications, including scientific journals, and scientific achievements according to accepted rules
Skills	**P8S_UW**	has scientific and technological skills related to the methodology and methodology of conducting scientific research and a critical assessment of the results obtained can creatively interpret the results obtained and look for their application
Skills	**P8S_UO**	knows how to initiate and conduct discussions on research topics, obtained results and their interpretation
Social competence	**P8U_K**	knows what is the activity leading to the creation of acquis in violation of the law, including copyright, or decency in science, and that it is a premise for the resumption of the proceedings for conferring doctoral and postdoctoral degrees or the title of professor

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] R.W. Rousseau, Handbook of Separation Process Technology, John Wiley & Sons, 1987
[2] Winnicki T. Polimery czynne w inżynierii ochrony środowiska, Warszawa :Arkady
[3] Cyganowski P., Synthesis of Adsorbents with Anion Exchange and Chelating Properties for Separation and Recovery of Precious Metals - A Review, Solvent Extraction and Ion Exchange, 38:2, 143-165,

SECONDARY LITERATURE:

[4] Current magazine articles:. Separation Science and Technology , Solvent extraction and Ion Exchange,
[5] Cyganowski P ., Garbera K., Leśniewicz A., Wolska J., Pohl P. , Jermakowicz-Bartkowiak D.: The recovery of gold from the aqua regia leachate of electronic parts using a core-shell type anion exchange resin. Journal of Saudi Chemical Society. 2017, vol. 21, nr 6, s. 741-750, 3
[6] Jermakowicz-Bartkowiak D**.**, Kolarz B.N. Anionity polimerowe do odzyskiwania metali szlachetnych, Polimery, 58, 7-8, 524-532,2013

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

Dorota.Jermakowicz-Bartkowiak, Piotr Cyganowski