KAPITAŁ LUDZKI
NARODOWA STRATEGIA SPÓJNOŚCI

Projekt współfinansowany przez Unię Europejską w ramach Europejskiego Funduszu Społecznego

UNIA EUROPEJSKA
EUROPEJSKI FUNDUSZ SPOŁECZNY

Course title

Environmental chemistry and radiochemistry

ECTS code

13.3.0653

Name of unit administrating study

null

Studies

faculty	field of study	type	pierwszego stopnia
Wydział Chemii	Chemia	form	stacjonarne
		specialty	wszystkie
		specialization	wszystkie

Teaching staff

prof. dr hab. Bogdan Skwarzec; prof. dr hab. Tomasz Puzyn

Forms of classes, the realization and number of hours

Forms of classes

Lecture

The realization of activities

classroom instruction

Number of hours

Lecture: 30 hours

ECTS credits

2

classes - 30 h

tutorial classes – 5 h

student's own work – 15 h

Total: 50 h - 2 ECTS

The academic cycle

2024/2025 summer semester

Type of course

obligatory

Language of instruction

polish

Teaching methods

multimedia-based lecture

Form and method of assessment and basic criteria for eveluation or examination requirements

Final evaluation

Graded credit

Assessment methods

•written egzam with open questions (tasks)

•oral egzam

The basic criteria for evaluation

a positive grade from a written exam consisting of 30¸40 questions covering issues mentioned in the lecture's program content. Oral exam, only for those students who obtained from the written test 40-50% of the points possible to receive.

Method of verifying required learning outcomes

Required courses and introductory requirements

A. Formal requirements

basics of chemistry, analytical chemistry

B. Prerequisites

analytical chemistry and statistics

Aims of education

To acquaint students with the basics of trace analysis and phenomena of natural and artificial radioactivity.

To acquaint students with analytical and radiochemical methods in environmental research.

To acquaint students with the basics of radiometry, dosimetry and radiological protection.

To acquaint students with the validation of chemical and radiochemical methods.

To acquaint students with the risk assessment of chemical substances, including the principles of the European REACH system and the resulting legal obligations.

To familiarize students with the possibilities and limitations of modeling methods used in environmental protection, with particular emphasis on the

QSAR / QSPR and MM models.
To acquaint students with available software and the possibilities of its use in the process of chemical risk assessment.

Course contents

Trace analysis in environmental research, research methods and techniques.
Natural and artificial radioactivity, radioactive elements in nature, radiometry and radiochemical methods, doses of ionizing radiation, radiotoxicity and radiological protection, sources of radioactive contamination in the natural environment.
Validation in chemical and radiochemical analysis, criteria for evaluation of analytical results.
Problems of environmental pollution with chemical substances: accidents related to the uncontrolled release of chemical substances into the environment; history of environmental protection against chemical substances; sources of chemical pollution and an overview of the most important substances identified as hazardous; national and international strategies and regulations in the field of environmental protection against chemical substances (including the REACH Regulation); basic assumptions of the risk assessment of chemical pollution; the physicochemical properties of the compound of key importance for the chemical risk assessment; processes of the spread of chemical compounds in the environment; durability and degradation of chemical compounds; bioaccumulation and biomagnification phenomena in trophic networks; the concept of toxicity and types of toxic effects; chemical compounds referred to as PBT and vPvB acronyms.
Models of the relationship between chemical structure and activity / properties (Quantitative Structure-Activity Relationships QSAR and Quantitative Structure-Property Relationships, QSPR) as examples of mathematical probabilistic models used in the risk assessment of chemical compounds: the idea of QSAR / QSPR modeling; chemical structure descriptors; evaluation of the quality of available experimental data used in modeling; construction and validation of QSAR / QSPR models; available models applicable to the chemical risk assessment (EPI-Suite, PBT Profiler, SPARC).
Multi-component models of the spread of chemical pollutants in the environment (Multimedia mass-balance Models) as examples of mathematical deterministic models: the concept of a multi-component environmental model; application of multi-component models; levels of complexity and basic assumptions of particular types of models; division of models due to regional coverage; input data to the model and their sources; examples of commonly used multi-component models; the idea of modeling based on the combination of QSPR-MM techniques; creating exposure scenarios based on computer modeling.
Physical models used in risk assessment: the advantages and limitations of physical models; examples of physical models applicable to the determination of physicochemical properties (e.g. model for the partition of the compound between octanol and water), minimization of emissions (e.g. waste incineration model), prediction of transport processes in the environment (e.g. wind tunnel), bioaccumulation predictions (e.g. aquarium models) and toxicity (in vitro toxicity tests).

Bibliography of literature

Literature required to pass the course
Skwarzec B., Radiochemistry of the environment and radiological protection (Radiochemia środowiska i ochrona radiologiczna), DJ s.c., Gdańsk 2002 (in polish)
Skwarzec B., Determination of radionuclides in aquatic environment, [in:] Analytical measurements in aquatic environments, CRC Press, Taylor&Francis Group 2010
Puzyn T., Leszczynski J., Cronin M., Recent advances in QSAR studies: methods and applications. Challenges and advances in computational chemistry and physics. Springer 2010
Puzyn T., Leszczynska D., Leszczynski J., Quantitative structure-activity relationships (QSARs) in the European REACH System: Could these approaches be applied to nanomaterials? [in]: Practical aspects of computational chemistry: methods, concepts and applications, Springer 2009

The learning outcomes (for the field of study and specialization)

Knowledge

After completing the course, each student:
knows and understands the basic concepts of environmental chemistry and radiochemistry,
knows and understands analytical and spectroscopic methods used for quantitative determination of radioactive elements and nuclides,
understands the concept and application of validation in trace analysis and distinguishes and applies the basic criteria for the evaluation of analytical results,
understands the principles of the REACH system in Europe and the resulting legal obligations,
knows the most important theories describing the processes of the spread of chemical pollution on a regional scale and the whole globe, and basic with the physical and chemical laws on the basis of which these theories have been formulated,
knows the process of constructing and validating the QSAR and MM models, in accordance with the OECD recommendations.

Skills

After completing the course, each student:
in a comprehensible way, can present correct reasoning in environmental chemistry and radiochemistry,
knows modern techniques and instrumental methods for the determination of trace elements and radionuclides,

	is aware of the importance of natural and artificial radioactivity in human life, predicts, verifies and critically analyzes the results of experiments carried out, can relate the chemical properties of a compound to its fate in the natural environment, critically verifies the obtained results of modeling.
	Social competence After completing the course, each student: understands the need for further education in the field of environmental chemistry and radiochemistry, knows the basic principles of safe work with toxic substances and radioactive isotopes, makes the society aware of the impact of radioactivity and toxic substances on human life, knows the chemometric methods used in the chemical analysis of environmental samples, recognizes the need to carry out a risk assessment for newly designed chemicals in a social context (improving the quality of life of the society), can participate in the discussion about the problems of modern environmental protection based on thoroughly verified scientific arguments, exhibits a possibly independent, proactive approach to problems and creativity in independent and team work, shows an impeccable ethical attitude in the field of intellectual property and author's work.

Contact

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