POZNAN UNIVERSITY OF TECHNOLOGY

EUROPEAN CREDIT TRANSFER AND ACCUMULATION SYSTEM (ECTS)

COURSE DESCRIPTION CARD - SYLLABUS

Course name
Ionizing radiation and radiological protection [S2EJ1>PJiOR]

Course

Field of study
Nuclear Power Engineering

Year/Semester
1/1

Area of study (specialization)
–

Profile of study
general academic

Level of study
second-cycle

Course offered in
Polish

Form of study
full-time

Requirements
elective

Number of hours

Lecture
30

Laboratory classes
15

Other
0

Tutorials
30

Projects/seminars
0

Number of credit points

5,00

Coordinators

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Lecturers

Prerequisites

1. Knowledge: Knowledge of physics and chemistry at the level of the basic secondary school leaving exam and the lecture cycle in general chemistry and physical chemistry, as well as knowledge of issues related to the basics of nuclear physics. Knowledge of the structure of the atom, the atomic nucleus, the basics of mathematical statistics. 2. Skills: Solving algebraic equations and systems of equations, formulating chemical, physicochemical and environmental problems in the language of mathematics, solving simple differential and logarithmic equations. The student has the ability to independently perform laboratory experiments in the field of physical chemistry and physics. Is able to formulate conclusions logically resulting from the obtained experimental results. 3. Social competences: The student is aware of the limitations of his or her own knowledge and understands the need to further deepen it. He understands that preparing for laboratory classes is his homework. He is aware that he is a subject and not an object of education.

Course objective

To familiarize students with the basics of issues related to ionizing radiation, radiometry, elements of radiological protection and atomic law. Familiarization with basic dosimetric devices and their operation. Presentation of problems related to risk assessment of working with radioactive substances. Developing students' ability to characterize and describe radiological hazards. To familiarize students with the directions of development of methods for measuring various types of ionizing radiation. Preparing students to implement projects related to radiological protection. Developing the ability to develop and present the risks associated with the use of ionizing radiation sources and calculate doses.

Course-related learning outcomes

Knowledge:
1. Has knowledge about the characteristics of various types of nuclear radiation. Describes the phenomena of the interaction of ionizing radiation with matter, including biological systems.
2. Understands the connections and dependencies between the type of radiation, distance from the source, its activity and residence time and the absorbed dose. Has general knowledge of the use of radioactive substances in technology, industry, science and medicine.
3. Knows the principles of dealing with sources of ionizing radiation and characterizes probable threats. Distinguishes between types of ionizing radiation and classifies the threat. Knows the basic regulations arising from nuclear law.
4. Has basic knowledge of the basics of radiation protection. Analyzes the operation of various types of dosimetric devices and compares their effectiveness.
5. Interprets the results of dose calculations. Is able to develop and present the effects of work in the form of a paper report and/or multimedia presentation.

Skills:
1. Is able to plan and carry out simple experiments in the field of physical chemistry and radiometry. He can describe a laboratory experiment, make a qualitative and quantitative analysis of the results, and critically comment on his own conclusions. 2. Is able to formulate general and partial conclusions based on the results obtained from the experiment and his own knowledge. Has the ability to use subject literature, subject lectures, databases and other sources. 3. Is able to work in the laboratory in accordance with safety and hygiene rules. Knows the requirements for working with radioactive substances and electrical devices. Able to work and cooperate in a team of several people. 4. Is able to make calculations regarding doses and protection against ionizing radiation.

Social competences:
1. Is aware of his own responsibility for working in a team.
2. Is aware of the limitations of his own knowledge; understands the need for further education.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Lecture:
1-part written final exam, duration 90 minutes, the exam includes a skills test (2 tasks), a knowledge test (3 questions); additionally, continuous assessment during each class (activity);
Auditorium exercises:
1-3 colloquia during classes per semester final test (up to 1.5 hours) during the last class rewarding activity
Laboratory exercises:
Final grade from the laboratory based on many knowledge tests and a colloquium on tasks.

Programme content

The module program covers the following topics:
Basics of ionizing radiation production and its detection. Radiological quantities and units used in a given field. Physical properties and control parameters of radiological devices used in a given field. The impact of ionizing radiation on humans. Dose
effective and equivalent and radiation risk. General assumptions of radiological protection. Field-specific aspects of radiological protection. Doses obtained as a result of using the appropriate ones
for a given field. Principles of optimization. Quality assurance program. National and European legislation,

international recommendations.
Basic occupational health and safety regulations and the basics of work in a radioisotope laboratory. Statistical analysis of radiometric measurement results. Measurement methods: meter characteristics Geiger-Muller; determination of the half-life of long-lived radioisotopes on the example of potassium K 40; determination of scintillation counter characteristics; determining the semi-absorbent layer for various materials, for gamma radiation; spectrometric measurements - spectra measurements. calculations of the activity of radioactive sources, gamma radiation doses from point sources (shields), working time with gamma radiation sources, calculation of the thickness of gamma radiation shields, calculation of the thickness of beta radiation shields, work with radiometers - calibration of several (selected) radiometers, practical use of radiometers.

Course topics

The lecture program covers the following topics:
Basics of ionizing radiation production and its detection. Radiological quantities and units used in a given field. Physical properties and control parameters of radiological devices used in a given field. The impact of ionizing radiation on humans. Dose effective and equivalent and radiation risk. General assumptions of radiological protection. Field-specific aspects of radiological protection. Doses obtained as a result of application appropriate for a given field. Principles of optimization. Quality assurance program. National and European legislation, international recommendations
The laboratory program covers the following topics:
Basic occupational health and safety regulations and the basics of work in a radioisotope laboratory. Statistical analysis of radiometric measurement results. Measurement methods: meter characteristics Geiger-Muller; determination of the half-life of long-lived radioisotopes using the example of potassium K 40; determination of scintillation counter characteristics; determining the semi-absorbent layer for various materials, for gamma radiation; spectrometric measurements - spectra measurements.
The exercise program covers the following topics:
Calculating tasks regarding: activity of radioactive sources, gamma radiation doses from point sources (shields), working time with gamma radiation sources, thickness calculation shields against gamma radiation, calculating the thickness of shields against beta radiation, working with radiometers - calibration of several (selected) radiometers, practical use of radiometers.

Teaching methods

Lecture delivered remotely using synchronous access methods.
Teaching methods: informative lecture, lecture with multimedia presentation, problem-based lecture; laboratories, exercise method, computational method, problem method, case study, measurement, observation, experiment, accounting exercises. Work in measurement teams.

Bibliography

Basic:
1. W.Gorączko, Ochrona radiologiczna, Politechnika Poznańska, Poznań, 2011
2. W.Gorączko, Elementy chemii jądrowej, Politechnika Poznańska, Poznań 2012
3. W.Gorączko, Radiochemia i ochrona radiologiczna, Politechnika Poznańska, Poznań, 2003
4. W..Szymański, Chemia jądrowa, PWN, Warszawa, 1999
5. J.Sobkowiak, Chemia jądrowa, PWN, Warszawa, 1990
6. S.Magas, Technika izotopowa, Politechnika Poznańska, Poznań, 1994
7. B.Dziunikowski, Zastosowanie izotopów promieniotwórczych, AGH, Kraków, 1995

Additional:
1. Prawo atomowe, Ustawa z dnia 29 listopada 2000 r.,(Dz.U. Nr. 3, poz. 18) z 2001 r. z uwzględnieniem tekstu jednolitego z 14 lutego 2007 r. (Dz. U. Nr 42, poz. 276) z późniejszymi zmianami.
2. A.Hrynkiewicz, Człowiek i promieniowanie jonizujące, PWN, Warszawa, 2001
3. W.Szymański, Elementy nauki o promieniowaniu jądrowym dla kierunków ochrony środowiska, UMK, Toruń, 1999
4. A.Niesmiejanow, Radiochemia, PWN, Warszawa, 1995
5. A.Vertes, I.Kiss, Nuclear chemistry, Akademia Kiado, Budapest, 1987
6. J.Kroh, Chemia radiacyjna, PWN, Warszawa, 1995 7. Principles of radiochemistry, H.Kay, Butterworths, London, 1985

Breakdown of average student's workload

	Hours	ECTS
Total workload	137	5,00
Classes requiring direct contact with the teacher	77	3,00
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	60	2,00