STUDY MODULE DESCRIPTION FORM

Name of the module/subject		Code
Radiochemistry and Radiation Protection		**1010702311010710050**

Field of study	Profile of study (general academic, practical)	Year /Semester
Environmental Protection Technologies	**(brak)**	**1 / 1**
Elective path/specialty	Subject offered in:	Course (compulsory, elective)
-	**Polish**	**obligatory**

Cycle of study:	Form of study (full-time,part-time)
Second-cycle studies	**full-time**

No. of hours					No. of credits
Lecture: **2**	Classes: **-**	Laboratory: **2**	Project/seminars: **-**		**2**

Status of the course in the study program (Basic, major, other)	(university-wide, from another field)
(brak)	**(brak)**

Education areas and fields of science and art	ECTS distribution (number and %)
technical sciences	**2 100%**
Technical sciences	**2 100%**

Responsible for subject / lecturer:

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Prerequisites in terms of knowledge, skills and social competencies:

1	**Knowledge**	Background of nuclear physics and statistical methods
2	**Skills**	The student possesses the skill independent executing laboratory experiments in the range of the nucealt physics and radiology. From the experimental results he can logically formulate conclusions.
3	**Social competencies**	The student understand the limitation of own knowledge and understands that he need more far greater depth. He understands that the preparation to the laboratory exercises is his home work. Student is the subject and not the object of the education.

Assumptions and objectives of the course:

Introduction of the students with the radiological protection principles and the elements of the Polish atomic right. Introduction with basic instruments, dosymeters and their service. Performance of problems connected with the evaluation of the work risk with radioactive substances. Practice of the skill of characterizing by the students of the risk. Introduction of the students with the development of the measurement methods of the nuclear radiation. Student's preparation to the realization of projects connected with the radiological protection. The practice of the skill of the study and representing risk connected with applying the ionizing radiation and calculation of the doses.

Study outcomes and reference to the educational results for a field of study

Knowledge:

1. Student has knowledge on the subject of the characteristic features of the various type of the nuclear radiation. - [K_W07]
2. Student describes the phenomena of the influence of theionizing radiation ionizing with the matter - escecially with biological systems. - [K_U01]
3. Student understand the relationships and dependence among the kind of the ionizing radiation, distance from the source, his activity and the time and absorbed dose - [K_U05]
4. Student has general knowledge about using of radioactive substances and sources in technique, industry, science and medicine. - [K_W07]
5. Student knows the principles how work and use rarioisotope sources and can characterized probable risk - [K_U05]
6. Student distinguishes the kinds of the nuclear radiation and makes the classification of the risk. - [K_U02]
7. Student knows basic controls resulting from the Polish atomic right. - [K_U01]
8. Student possesses basic knowledge on the basic radiation protection. - [K_U05]
9. Student analyses the working of the various type of instruments and dosymeters. - [K_W07]
10. He interprets the results of the dose calculations. - [K_U01]
11. He be able to work out and introduce the effects of the projects work in the figure of paper reports and multimedia introduction. - [K_U02]

Skills:

1. The student knows how to plan and conduct simple experiments from the range of nuclear physics and dosimetry. - [K_U01]
2. The student knows how describe the laboratory experiment, to execute the qualitative and quantitative analysis of results, to refer to own conclusions critically - [K_U02]
3. The student knows how formulate general and partial conclusions on the basis of got results from experiment and own knowledge. - [K_U05]
4. The student knows how to use the literature of the object, objective lecture, the bases of given and different sources. - [K_U05]
5. The student be able work in the laboratory with the principles of safety and hygiene. - [K_U01]
6. The student knows requirements relating the work with dangerous substances - i.e. radiation sotrces and electric devices. - [K_U02]
7. The student be able work and co-operate in a few people team. - [K_U05]

Social competencies:

1. The student responsibility for the work in the team. - [K_K02]
2. The student limitation of own knowledge; he understands that need the more education. - [K_U05]

Assessment methods of study outcomes

Constant spoken control.

Course description

Basic knowledge in :

Basic elements of nuclear physics - nucleus parameters and models, nuclear reactions, nuclear fission, alfa, beta, gamma and neutron radiations;

Radiation phenomena; natural and artificial radioactive elements,

Natural radioactivity of water, soil, structural materials;

Basic knowledge in nuclear physics and techniques;

Interaction of radiation with matter;

Measurement of nuclear radiation - gamma, beta, alfa and neutron measurement techniques;

Some elements of the Polish Atomic Law;

Basic elements of radiation protection - radioactive sources, doses and dose rates, radiation attenuation, ionizing radiation shields, radioactive waste and its utilization, health and safety precautions, personal protection, radiation hormesis phenomena;

Influence of ionizing radiation on biological objects and environment;

Radiological monitoring (working place and environment);

Contamination and decontamination procedures;

Nuclear energy production; legal aspects of nuclear energy;

Radiological safety of nuclear power plant;

Nuclear accidents;

Waste management;

Application of radiometric methods in controlling typical factories processes (chemical, mechanical and hydraulic);

Application of radioactive elements - technical, medical and environmental protection;

Laboratory course description:

Introductory Exercise 1 - Basic elements of radiation protection - radioactive sources, doses and dose rates, radiation attenuation, ionizing radiation shields, health and safety precautions, personal protection;

Exercise 2 - ionizing radiation measurements, dosimeter equipments, ionizing radiation shields, doses and dose rates measurements, measurement of contamination and decontamination procedures;

Exercise 3 - dosimeter calibration, isodose calculation and staking out; discovering of losed ionizing source;

Exercise 4 - statistical basis for ionizing radiation measurements; gamma and beta measurement techniques (Geiger-Muller detectors);

Exercise 5 - measurement of decay constant and half-life T1/2 for long-living radioisotopes(40K);

Exercise 6 - alfa, beta, gamma, and neutron measurement techniques (photomultipliers and scintillation probes, crystal and plastic detectors);

Exercise 7 - radiation attenuation (alfa, beta, gamma and neutron, ionizing radiation) shields; measurements of the linear absorption coefficient of Fe, Cu, Pb and unknown material;

Exercise 8 - measurements of the natural radioactivity of : geological, water, soil and structural materials from some environmental areas; collecting and preparation of environmental samples;

Exercise 9 - flow and leakage measured (flow measurement by peak timing, two points method, velocity profiles;

Exercise 10 - gamma level gaging;

Exercise 11 - alfa, beta and gamma spectrometry; identification of unknown radioisotope;

Basic bibliography:

1. W.Goraczko, Radiochemistry and Radiation Protection, PP Poznan 2003.

2. W.Goraczko, Radiation Protection, PP Poznan 2011.

3. W.Goraczko, "Nuclear Chemistry", PP Poznan 2012.

4. B.Dziunikowski, Application of Ionizing Radiation Sources in Techniques, Agriculture, Medicine; AGH, Kraków 1995

5. Radiation Protection - materials from IAEA (International Atomic Energy Agency), Polish National Atomic Energy Agency and Polish Nuclear Society

6. J.Kroh, Radiation Techniques, PWN Warszawa, 1980

Additional bibliography:

1. Niesmiejanow, Radiochemistry; PWN Warszawa, 1995

2. H.A.C.Mc Kay, Principles of Radiochemistry; London Butterworths, 1985

Result of average student's workload

Activity	Time (working hours)
1. Preparation to the lecture and mathematical practices.	30
2. The home work of some chosen questions connected with the nuclear energetics.	20

Student's workload

Source of workload	hours	ECTS
Total workload	100	2
Contact hours	20	1
Practical activities	80	2