SYLLABUS

1. Data about the program of study

1.1	Institution	Technical University of Cluj-Napoca
1.2	Faculty	Faculty of Electrical Engineering
1.3	Department	Power Systems and Management
1.4	Field of study	Energy Engineering
1.5	Cycle of study	Master of Science
1.6	Program of study/ Qualification	Modern power systems - Cluj-Napoca in English language
1.7	Form of education	Full time

2. Data about the subject

2.1	Subject name				Fundamentals of nuclear theory-PROJECT	
2.2	Course responsible/ lecturer				Prof. dr. Ioan ARDELEAN; ioan.ardelean@phys.utcluj.ro	
2.3	Teachers in charge of Seminars/ Laboratory/ Project				Prof. dr. Ioan ARDELEAN; ioan.ardelean@phys.utcluj.ro	
2.4 Year of study	1	2.5 Semester	1	2.6 Type of assessment *(E – exam, C – colloquium, V – verification)*		C
2.7 Subject category	*DF – fundamental, DD – in the field, DS – specialty, DC – complementary*					DF
	DI – compulsory, DO – elective, Dfac – optional					DI

3. Estimated total time

3.1 Number of hours per week:	3	of which	3.2 Course	2	3.3 Seminar		3.3 Laboratory	1	3.3 Project	
3.2 Total hours per semester	14	of which	3.5 Course	0	3.6 Seminar	0	3.6 Laboratory	0	3.6 Project	14

3.7 Individual study:	
(a) Manual, lecture material and notes, bibliography	12
(b) Supplementary study in the library, online and in the field	8
(c) Preparation for seminars/laboratory works, homework, reports, portfolios, essays	6
(d) Tutoring	4
(e) Exams and tests	2
(f) Other activities	4

3.8 Total hours of individual study *[sum (3.7(a) to 3.7(f))]*	36
3.9 Total hours per semester *[sum of 3.4 and 3.8]*	50
3.10 Number of credit points	2

4. Prerequisites (where applicable)

4.1	Curriculum	- graduation of a general physics course containing notions of electricity, magnetism and quantum physics
4.2	Competences	- to be able to graphically represent experimental data with Open Source programs -to have basic knowledge of quantum physics and statistics.

5. Requirements (where appropriate)

5.1	For the course	Video projector / online (Teams)
5.2	For the applications	Mandatory presence at the laboratory according to the UTCN regulation.

6. Specific competences

Professional competences	After completing the project, students will accumulate knowledge in nuclear physics being able to: - to describe the structure of the atom, identifying the mass and charge of each elementary particle that goes into its composition; - explain the stability of nuclei based on the properties of nuclear forces; - define the types of radioactive decays and specific attenuations; - define the activity of a radioactive source and the half-life.
Cross competences	- Responsible execution of professional tasks in conditions of restricted autonomy (realization of homework for independent study); - Awareness of the need for continuous training; effective use of learning resources and techniques, for personal and professional development - efficient use of communication and training resources (Internet, databases, etc.), including using foreign languages.

7. Expected learning outcomes

Knowledge	Understanding the mechanisms of interaction of gamma and beta radiation with matter. Knowledge of radiation attenuation principles and absorption coefficients specific to different materials. Understanding the operating principles of experimental techniques used in nuclear physics. Knowledge of methods for the analysis and processing of experimental data.
Skills	Performing experimental measurements regarding radiation absorption in different materials. Using OpenSource software for graphical representation and analysis of experimental data. Determining absorption coefficients based on the obtained experimental data. Interpreting and presenting experimental results in a scientific report.
Responsibility and autonomy	Carrying out experimental activities responsibly and in compliance with safety regulations. Independently accomplishing individual tasks and collaborating efficiently within the project team. Using bibliographic and software resources autonomously for documentation and data analysis.

8. Discipline objectives (based on specific competencies acquired)

8.1	General objective	Acquisition of knowledge of nuclear physics in order to obtain competence in the field of nuclear engineering.
8.2	Specific objectives	• Knowledge of the structure of the atom and the nucleus; its stability • Know the types of radioactive decays and their interaction with the substance. • Know the main techniques for detecting radiation.

9. Contents

9.1. Project		Number of hours	Teaching methods	Additional remarks
1	Presentation of the project topic: Absorption of gamma and beta radiation in materials. Presentation of the software to be used,	2	Exemplification and exposition.	The equipment from the university will be used

	distribution of the roles of the project team members and the requirements for the completion of the project		Problematization, Modeling case study, Learning through discovery	
2	Evaluation of data with OpenSource software (QTIplot) and information that can be extracted.	2		
3	Experimental determinations on the absorption of gamma radiation in lead and concrete	2		
4	Experimental determinations on the absorption of beta radiation in aluminum	2		
5	Comparative processing of experimental data and extraction of absorption coefficients	2		
6	Presentation and analysis of individual reports written by students	2		
7	Project self-assessment	2		

Bibliography

1. I. Ardelean, Fundamentals of nuclear physics-lecture notes (PDF file, RO)
2. I. Ardelean, Introducere in mecanica cuantica, Editura U.T.Press, Cluj-Napoca, 2002, ISBN 973-8335-24-8(199 p)
3. QTIPLOT-soft open source pentru analiza datelor (https://www.qtiplot.com/download.html)
4. http://hyperphysics.phy-astr.gsu.edu/hbase/hframe.html
5. Prof. Markus Klute, MIT, USA, Introduction to nuclear and particle physics, Note de curs online
6. https://ocw.mit.edu/courses/8-701-introduction-to-nuclear-and-particle-physics-fall-2020/

10. Alignment of course content with expectations of the epistemic community, professional associations, and representative employers in the field

The content of the discipline and the skills acquired correspond to the expectations of the professional organizations and companies in the field where students carry out internships and/or take up a job, as well as the national quality assurance bodies (ARACIS)

11. Assessment

Activity type	10.1 Assessment criteria	10.2 Assessment methods	10.3 Weight in the final grade (%)
11.1 Project	The ability to apply the accumulated knowledge in practice, in different contexts. The ability to present the results obtained.	Formative assessment along the way. Evaluating the quality of the report and the ability to answer questions related to the report.	100%
11.2 Minimum standard of performance: presentation of a report that includes the analysis of experimental data			

Date of completion	Lecturers	Title/ Surname/ Name:	Signature
	Course	Prof. dr. Ioan ARDELEAN	
	Applications Seminar/ Laboratory/ Project	Prof. dr. Ioan ARDELEAN	

Endorsement of the Director of the department coordinating the course, only if this differs from the department organizing the study program.	**Head of Department Power Engineering and Management** Assoc. Prof. Eng. Horia G. BELEIU, PhD

Date of approval in the council of the Department of Power Engineering and Management September 2025	**Head of Department:** Assoc. Prof. Eng. Horia G. BELEIU, PhD
Date of approval in the Faculty of Electrical Engineering Council September 2025	**Dean:** Assoc. Prof. Eng. Andrei C. CZIKER, PhD