Ministry of Higher Education and Scientific research

Salahaddin University-Erbil

College of Education

Department of Physics

(Course book/First Semester)

4th stage

Subject: Nuclear Physics Lab

Assistant Lecturer

GOVAR MUAYAD ABDULLAH

Course book

General information:

1. Course Title	Nuclear Physics Lab
2. Lecturer in Charge	**GOVAR MUAYAD ABDULLAH**
3. Department	Physics/ College of Education
4. Course Language	English + Kurdish
5. Course Code	Non
6. Course Level	Bachelor science
7. Course Coordinator(s)	Hiwa Hamad Azeez
8. Contact	**E-mail:** govar.abdullah@su.edu.krd govarmuayadabdullah@gmail.com
9. Other Course teacher(s)	Assit.Prof. Habeeb hanna Mansur Lect. Hiwa Hamad Azeez
10. Time (in hours) per week	**Practical:** (2 Hours per week)
11. Office hours	Sunday from 08:30 AM to 2:30 PM. Thursday from 08:30 AM to 12;30 PM.
12. Course Type	Compulsory (Core)
14. Teacher's academic profile	GOVAR is Lecturer of High Energy Physics in the Department of Physics. **B.Sc. study between 2007 and 2011, in salahhaddin Uni./College of Edu./Erbil** **Physics assistant 2011-2015, in salahhaddin Uni. /College of Edu. /Erbil.** **MSc. study 2015-2018, in Uni. Of Calabria/Italy** **Teaching:** **Practical physics :(Electricity lab. + Atomic lab. + Advanced electricity and Magnetism lab. Mechanics and properties lab, and Nuclear lab).**
15. Keywords	Detector, Radiation source, Rad lab program, magnetic field, source activity, dead time, operating voltage, Operating Plateau ,Geiger Muller detector , scintillation detector, multi-channel analyzer(MCA), Radiation decay.

Course descriptions:

The importance of nuclear physics lab is to let students to have practical information about nuclear physics and see the instruments which are used in the nuclear labs. This module also provides better understanding of nuclear physics and number of topics in it and, to have knowledge concerning some nuclear sources. They must make the differences between Particles, atoms and nuclear. To know something about nuclear radiation and to know the effect of radiation on human bodies. This course is totally practical; we have twelve experiments during the year. We explain the basic idea of the experiments in details including the equations and some solved problems. We have twelve experiments during the year. We explain the basic idea of the experiments in details including the equations and some solved problems. Then, for next week students are required to do experiments weekly during the course, this means each student takes an experiment, after doing experiments they prepare reports and submit it next week. Each report takes 10 marks (daily oral quiz for each experiment takes 4 marks, calculation and graphs take 3 M and discussion takes 3M). In case of a student misses an experiment and not bringing a report, they will be punished. and each student must be preparing a poster for different experiment and present it individually one time in the class during the course.

The aim of this module is to provide students with:

- Good understanding about nuclear physics practically.
- To give information about nuclear radiation and affecting on human bodies.
- Understanding of the decay of some sources and why do they decay.
- To understand of detectors, how are they designed and how they work?
- To see how the gamma ray, alpha and beta particles generated and what is happening when they interact with human bodies.

Assessment scheme and points calculation:	
Tools	**weight**
1. Students have to prepare reports every week:	**5 points**.
2. Daily Activities	**5 points**.
3. Practical exam will be done after the whole semesters:	**5 points.**
4. Final exam which is called theoretical over practical exam should be done at the end of second semester:	**10 points.**
Report+ Daily Activities	**% 10**
Practical Exam	**%5**
Theoretical/Practical Exam	**%10**
Total points for this course lab is	**%25**

COURSE PEDAGOGICAL METHODS OF TEACHING AND LEARNING ACTIVITIES:

- The course will put **students at the center of the class** and it will allow them to learn and perform interpreting through practice.
- Students will receive material to read at home. Then, for next week students are required to do experiments weekly during the course, this means each student takes an experiment, after doing experiments they **prepare reports** and submit it next week.
- Students will take **quiz** for each experiment every week orally, and each student must be **preparing a poster** for different experiment and present it individually one time in the class during the course.
- **Problem Based Learning (PBL),** finding a problem and proper solution for it.
- **Competence Based Learning (CBL),** teaching based on competences of students according to knowledge, skills and, attitude. Make connection between students past learning and current learning.

Nuclear physics laboratory student learning outcomes:

After successful completion of this course students should be able to:
1. **Knowledge and explains** of how nuclear energy liberates and use for production of power. 2. How to **operate** the nuclear radiation equipment's. 3. How to **measure** nuclear radiation doses, and protect our self from nuclear radiation hazards. 4. **Understanding** of basic idea of Atoms and make the differences between particles, atoms and nuclear physics. 5. **Describe and Knowledge** of Nuclear sources and how they decay. 6. **Explain and Understanding** of detectors, why are they used? And how they work? 7. **Introduce and define** the gamma ray, alpha and beta particles and make the differences between them. 8. **Knowledge and estimate** of the statistical nature of radiation. 9. **Indication and explain** about the effect of magnetic and electrical fields on the particles.

COURSE CONTENT:

University of Salahaddin/ College of Education/Physics Department			
ACADEMIC CALENDAR			
Date	PROGRAMME	Module name and code/content description	Workload/Lectures(hrs)
01Oct.2022		Nuclear Lab	**16**
First Semester			
01 October. 2022 – 07 January. 2010			
11 Sep. – 08 Oct. 2022	Week1	**Introduction**	2
18 Sep. – 15 Oct. 2022	Week2	**Poisson's distribution and Gaussian distribution of radioactive decay.**	2
25 Sep. – 22 Oct. 2022	Week3	**Operating Plateau of Geiger -Muller detector.**	2
02 Oct. – 29 Oct. 022	Week4	**Diffraction of β- particles in statically magnetic field.**	2
09 Oct. – 05 Nov. 2022	Week5	**Absorption coefficient and mass coefficient of γ-ray.**	2
20 Nov. – 26 Nov. 2022	Week6	**Verification of Inverse square law for Gamma- Ray.**	2
27 Nov. – 03 Dec. 2022	Week7	**Review week**	2
07 Dec. 2022	**Final examination**		2
End of Dec.2022	**Online result**		
SEMESTER BREAK (27 December – 07 January 2022) **SECOND SEMESTER (07 February – 27 May 2022)**			

	Activities

COURSE ASSESSMENT TOOLS:

Student Workload (Pre. And Post. lectures and Preparations for Assessments)				
No.of weeks	**Course contents**	**Workload**	**Preparation for Quizzes,assig. & projects**	**Exams & Preparation exams**
Week 1	**Introduction**	2		
Week 2	**Poisson's distribution and Gaussian distribution of radioactive decay.**	2	3	
Week 3	**Operating Plateau of Geiger -Muller detector.**	2	3	
Week 4	**Diffraction of β- particles in statically magnetic field.**	2	3	
Week 5	**Absorption coefficient and mass coefficient of γ-ray.**	2	3	
Week 6	**Verification of Inverse square law for Gamma- Ray.**	2	3	
Week 7	**Review week**	2		
Week 8	**Final examination**	2		7
		16	15	7
38				

	Activities

WORKLOAD AND TOTAL HOURS CALCULATION OF THIS COURSE:

16 hrs lectures
38 hrs assess. + Preparation.
54 hrs Total
54/27=2 ECTS

Physics undergraduate Program-level student learning outcomes:
1. Students will **demonstrate** proficiency in mathematics and the mathematical concepts needed for a proper understanding of physics. And Write correct and coherent mathematical proofs. 2. **Describe and explain** the crystallography of materials. And Provide students to work in (Inorganic chemistry, solid state physics, Mechanical Engineering, use materials in Medical Physics and electronic engineering for understanding the formation and electronic properties of solid materials). 3. Students will **show that** they have learned laboratory skills, **enabling** them to take **measurements** in a physics laboratory and **analyze** the measurements to draw valid conclusions, and make connection between the taken materials and daily life applications. 4. Students will be **capable** of oral and written scientific communication, and will **prove that** they can think critically and work independently, and **understanding** of how physics knowledge has shaped our understanding of the world and how it may help to solve complex problems in the future. 5- Get the **knowledge** about forces, helps the students in their daily life, and **describe and analyses** electromagnetic wave propagation in different mediums. 6- **Understand** the concept of constant relative motion of different bodies in different frames of references. 7- **Explain** the concept of circuit laws and network theorems and apply them to laboratory measurements.

8- **Identify** the software and hardware components of a personal computer system, and **application** of programs in computer laboratories.

9- **Describe** how the amplitude and frequency of sound waves shape the nature of the sounds we hear also, **Define** how energy is propagated by waves. And also **describe** the concepts and importance of wavelength, wave frequency, amplitude, and velocity.

10- **Describe and explain** (Heat, temperature, ideal gas equation of state, laws of thermodynamic).
11- **Describe knowledge** of the behavior of light, and **Inspire** interest for the knowledge of concepts in physical and geometrical optics.

12- **Able** to learn the basics concepts of atomic structure that have direct relevance to the fundamental concepts of electronics, and Able to **recognize** the fundamental particles of atom.

13- **Explain** the notion of constants of the motion and their relation to cyclic variables as well as **derive** Hamilton-Jacobi theory from this point of view, and **describe** the basics of qualitative dynamics and Chaos theory.

14- **Thinking properly** and quickly of principles of modern physics, getting an idea of what available before modern physics came through, and also define both of classical and modern physics, and get information about special relativity and general relativity.

15- **Understand** the emergence of Quantum Mechanics and the failure of Classical Mechanics, how particle behavior in the microscopic world differs from the one in the macroscopic world, and **applies** principles of quantum mechanical to calculate observables on known wave functions.

16- **Understanding** of basic idea of Atoms and make the differences between particles, atoms and nuclear physics, **describe and Knowledge** of Nuclear sources and how they decay, and **explain** and Understanding of detectors, why are they used? And how they work?

COURSE LEARNING OUTCOMES AND UNDERGRADUATE PROGRAM-LEVEL STUDENT LEARNING OUTCOMES MAPPING:

Nuclear physics learning outcomes	Physics undergraduate Program-level student learning outcomes															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1- **Knowledge and explains** of how nuclear energy liberates and use for production of power.	A		C											A	B	C
2-How to **operate** the nuclear radiation equipment's.			C					A								B
3-How to **measure** nuclear radiation doses, and protects our self from nuclear radiation hazards.	B		C				A								A	
4- **Understanding** of basic idea of Atoms and make the differences between particles, atoms and nuclear physics.		A												B	C	C
5- Describe and Knowledge of Nuclear sources and how they decay.			C						A	A						B
6- Explain and Understanding of detectors, why are they used? And how they work?			C						B							C
7- Introduce and define the gamma ray, alpha and beta particles and make the differences between them.			C									A				A
8- Knowledge and estimate of the statistical nature of radiation.	B		C				B									
9- Indication and explain about the effect of magnetic and electrical fields on the particles.			C		B			B				A				

Performance goals

A	B	C
Beginning	**Intermediate**	**Advanced**

Course Reading List and References:

1. Nuclear science Experiments with digital Electronics.
2. “Cassy lab cataloge 2”, 2013, by Michael Hund, Karl- Heinz, Timm, werner.