Universidad Zaragoza

Year : 2019/20

26929 - Nuclear and Particle Physics

Syllabus Information

Academic Year: 2019/20
Subject: 26929 - Nuclear and Particle Physics
Faculty / School: 100 -

Degree: 447 - Degree in Physics

ECTS: 6.0
Year: 4
Semester: First semester
Subject Type: Compulsory
Module: ---

1.General information

1.1.Aims of the course

Nuclear and Particle Physics are two specialities born in the twentieth century that have an enormous relevance in in the evolution of the society and share the instrumentation and methodology.

1.2.Context and importance of this course in the degree

In Quantum Physics I and Quantum Physics II the students acquire basic knowledge about the quantum structure of atoms and molecules. In the present course, they will go from atoms to nuclei and from the latter to elementary particles, the quarks and leptons

1.3.Recommendations to take this course

It is advised to have passed Quantum Physics I and Quantum Physics II.

2.Learning goals

2.1.Competences

1 Understand subatomic physical phenomena.

2 Understand and apply nuclear models

3 Understand the Standard Model of Particle Physics and Fundamental Interactions

4 Understand and apply conservation laws and selection rules in nuclear and particle processes

2.2.Learning goals

1The student is capable of estimating nuclear masses and sizes.

2 The student is able to determine nuclear instability for the different decay processes

3 The student knows when each nuclear model can be applied and is able to apply it to simple cases

4 The student is able to associate the deuteron experimental data with the properties of nuclear forces

5 The student is able to calculate the spin, parity and magnetic moment of different nuclei using the nuclear shell model

6 The student is able to identify/classify the fundamental interactions according to cross sections and decay widths.

7 The student handles correctly tables of radioactive isotopes and tables of particles.

8 The student is able to measure a beta decay spectrum and to calculate the corresponding Kurie plot

9 The student is capable to apply relativistic and non-relativistic kinematics to nuclear and particle reactions and decays.

10 The student knows the most important processes of nuclear fusion in stars and nuclear fission in nuclear reactors.

2.3.Importance of learning goals

This course will enable students to understand the theoretical and experimental foundations of nuclear and particle physics. They will be able to know and predict properties of nuclei and elementary particle. They will also know the fundamental interactions and the Standard Model of Particle Physics.

3.Assessment (1st and 2nd call)

3.1.Assessment tasks (description of tasks, marking system and assessment criteria)

1 A continued assessment (**A mark**), solving problems and questions during the classes, with a duration previously established, will take into account the autonomous work and study of the students throughout the course. The maximum score will be 10 points.

2 The course will also comprise practice sessions in the laboratory with elaboration of written reports (**L mark**). The maximum score will be 10 points. Reports must be submitted not later than 15 days before the theoretical-practical assessment.

3 Theoretical-practical assessment the date established by the Faculty of Sciences (**P mark**). It is mandatory. The maximum score will be 10 points. Students that have not submitted the practice sessions report on time will have to do an additional assessment task in the laboratory that will be their L mark.

The final mark will be the greatest of

N=0.1*A+0.1*L+0.8*P or N=0.1*L+0.9*PN

A minimum of N=5 points is necessary to pass the course.

4.Methodology, learning tasks, syllabus and resources

4.1.Methodological overview

The methodology followed in this course is oriented towards the achievement of the learning objectives. The course is organized by combining lectures and practice lessons. In order to achieve the intended goals the strategy chosen by the teaching staff consists of using lectures for presenting to the students the basic knowledge required to face the solving problems session and laboratory practice. Interactive problem resolution classes and laboratory sessions will be conveniently intertwined.

4.2.Learning tasks

The 6 ECTS course includes the following learning tasks:

- Lectures (4.0 ECTS: 40 hours).
- Interactive solving problems sessions (1.5 ECTS: 15 hours).
- Laboratory sessions (0.5 ECTS: 5 hours). Laboratory reports must be submitted not later than 15 days before the theoretical-practical assessment. They will be announced by the professor at the beginning of the course.

4.3.Syllabus

The course will address the following topics:

- Topic 1. Nuclear global properties: phenomenology, nuclear mass, binding energy, nuclear sizes.
- Topic 2. Nuclear forces and models: two-body system in nuclear physics, the deuteron, the nuclear shell model, collective models.
- Topic 3. Nuclear decay modes: radioactivity, alpha, beta and gamma decay, nuclear fission.
- Topic 4. Nuclear reactions: resonances, nuclear fusion, nuclear astrophysics, nucleosynthesis.
- Topic 5. Elementary particle physics: historical introduction, particle accelerators, particle detectors.
- Topic 6. The fundamental interactions: leptons, hadrons and quarks, the standard model.

4.4.Course planning and calendar

Further information concerning the timetable, classroom, office hours, assessment dates and other details regarding this course, will be provided on the first day of class or please refer to the Facultad de Ciencias web https://ciencias.unizar.es/grado-en-fisica-0

4.5.Bibliography and recommended resources