# COURSE OUTLINE

## (1) GENERAL

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|---|---|---|---|
| **SCHOOL** | School of Science | | |
| **ACADEMIC UNIT** | Physics | | |
| **LEVEL OF STUDIES** | Undergraduate | | |
| **COURSE CODE** | **10YK401** | **SEMESTER** | **7** |
| **COURSE TITLE** | **Nuclear Physics** | | |

| **INDEPENDENT TEACHING ACTIVITIES** *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits* | **WEEKLY TEACHING HOURS** | **CREDITS** |
|---|---|---|
| Lectures (theory and exercises) | 4 | 6 |
| | | |
| | | |

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|---|---|
| **COURSE TYPE** *general background, special background, specialised general knowledge, skills development* | Specialized Knowledge |
| **PREREQUISITE COURSES:** | No |
| **LANGUAGE OF INSTRUCTION and EXAMINATIONS:** | Greek |
| **IS THE COURSE OFFERED TO ERASMUS STUDENTS** | Yes, in the English language for Erasmus students |
| **COURSE WEBSITE (URL)** | https://eclass.uoa.gr/courses/PHYS136/ |

## (2) LEARNING OUTCOMES

**Learning outcomes**

*The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.*

*Consult Appendix A*

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

The course invests on building upon the foundation of knowledge from the introductory course in Nuclear and Particle Physics, so that it would provide students with detailed knowledge of the fundamental symmetries involved in nuclear systems, while investigating the essential characteristics of nuclear reactions.

With the successful attendance and completion of the course, the student is in position to:

- Understand the fundamental interactions among nucleons, shaping the characteristics of nuclear matter.
- Determine the stability or disintegration of nuclear matter based on conservation principles and fundamental symmetries.
- Know the basic characteristics of nuclear structure and the radiation associated to its change.
- Understand the basic mechanisms behind reactions between nuclear isotopes

- Distinguish between microscopic and macroscopic degrees of freedom in nuclear matter
- Assess if a process is conserved or not based on fundamental symmetries and conservation laws.
- Calculate the stability of nuclei against potential decays based on theoretical models
- Apply the properties of the strong and weak nuclear interactions to explain stellar nucleosynthesis, as well as predict the isotopic behavior in technological applications.
- Explain fundamental subatomic phenomena in basic and applied level
- Evaluate theoretical models in comparison with experimental data
- Organize the approach to questions and problems in a methodical and organized manner

**General Competences**

*Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?*

| | |
|---|---|
| *Search for, analysis and synthesis of data and information, with the use of the necessary technology* | *Project planning and management* |
| *Adapting to new situations* | *Respect for difference and multiculturalism* |
| *Decision-making* | *Respect for the natural environment* |
| *Working independently* | *Showing social, professional and ethical responsibility and sensitivity to gender issues* |
| *Team work* | *Criticism and self-criticism* |
| *Working in an international environment* | *Production of free, creative and inductive thinking* |
| *Working in an interdisciplinary environment* | *……* |
| *Production of new research ideas* | *Others…* |
| | *…….* |

The course aims at the following general competences

Search for, analysis and synthesis of data and information, with the use of the necessary technology
Adapting to new situations
Decision-making
Working independently
Team work
Working in an international environment
Working in an interdisciplinary environment

Respect for the natural environment
Criticism and self-criticism
Production of free, creative and inductive thinking
Analytical and synthetic thinking
Critical thinking
Time management
Planning
Taking initiative/responsibility
Creativity
Determination
Communication skills
Information management
Self control skills
Meeting Deadlines and Keeping Schedules
Flexibility / Adaptability
Problem solving

## (3) SYLLABUS

- Nucleons and their interactions.
- The nucleon-nucleon strong interaction.
- Many-body Quantum Theory, Mean Field and models of nuclear structure.
- Experimental methodology and instrumentation in Nuclear Physics.
- Nuclear decays (α-, β-, γ-decay and fission).
- Exotic nuclei, elements of Nuclear Astrophysics.

## (4) TEACHING and LEARNING METHODS - EVALUATION

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|---|---|
| **DELIVERY**<br>*Face-to-face, Distance learning, etc.* | Face-to-face |
| **USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY**<br>*Use of ICT in teaching, laboratory education, communication with students* | Yes<br><br>Electronic communication with the students using ICT (Information and Communications Technology)<br>Computer-aided lectures, use of video Projectors, specialized instrumentation (eg radiation detectors)<br>eclass platform, instructors websites, use of online databases |
| **TEACHING METHODS**<br>*The manner and methods of teaching are described in detail.*<br>*Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.*<br><br>*The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS* | **Activity** / **Semester workload**<br>Lectures. exercises: 52<br>Seminars: 15<br>Individual Study/ Study and Analysis of bibliography / Preparation: 78<br>Educational Visits: 5<br><br>**Course Total: 150** |
| **STUDENT PERFORMANCE EVALUATION**<br>*Description of the evaluation procedure*<br><br>*Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other*<br><br>*Specifically-defined evaluation criteria are given, and if and where they are accessible to students.* | Final written exams in Greek.<br>Open-ended questions, Problem solving.<br>Oral examination.<br>Written term project. |

## (5) ATTACHED BIBLIOGRAPHY

*- Suggested bibliography*


- W.N. Gottingham & Greenwood*: "Introduction to Nuclear Physics", (translated)* G. & K. Dardanos Publishers
- Kenneth S. Krane: *"Introduction to Nuclear Physics", (translated)* Gutenberg Publications
- Samuel Wong: *"Introductory Nuclear Physics"* [electronic resource], Wiley Online
- B.R. Martin: *"Nuclear and Particle Physics"* [electronic resource], Wiley Online


*- Related academic journals:*

- Nature
- Nature Physics
- Scientific Reports
- Science
- Physical Review Letters
- Physical Review C
- Journal of Instrumentation
- Acta Physica Polonica A
- Nuclear Instruments and Methods in Physics Research A
- Nuclear Instruments and Methods in Physics Research B
- European Physics Journal A
- Journal of Physics G
- Physics Letters B
- Nuclear Physics A
- Nuclear Physics B
- Nuclear Science and Techniques
- Canadian Journal of Physics
- International Journal of Atomic and Nuclear Physics
- arXiv.org Preprints
- Procedia
- IAEA Technical Reports