COURSE OUTLINE

(1) GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Physics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**10YK402**	**SEMESTER**	**7**
COURSE TITLE	**ELEMENTARY PARTICLES**		

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

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Specialised
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/PHYS148/

(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 provides the student with basic knowledge on the properties and interactions of elementary particles. Upon the completion of the course, the student is able to:

- Know the elementary particles that compose the natural world, their properties (quantum numbers, masses) and interactions.
- Understand the theoretical basis of the classification of elementary particles through fundamental symmetries.
- Be familiar with the experimental processes for the detection and study of the properties of elementary particles (accelerators, detectors).
- Know basic elements of relativistic quantum mechanics (Klein-Gordon and Dirac equations) and their predictions for the properties of the particles that they describe (spin, antiparticles, interaction with the electromagnetic field).
- Handle the formalism for the calculation of production probabilities and distributions of particles in collision experiments (differential cross section).
- Calculate the cross section for simple processes of electromagnetic scattering.
- Know the main properties of the weak interaction (parity violation), as well as the experiments through which they have been determined.
- Understand the basic elements of the theory of the weak interaction and its carriers, as well as the phenomenological consequences for particle production, scattering and decay.

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
Adapting to new situations
Decision-making
Working independently
Team work
Working in an international environment
Working in an interdisciplinary environment
Production of new research ideas
Project planning and management
Respect for difference and multiculturalism
Respect for the natural environment
Showing social, professional and ethical responsibility and sensitivity to gender issues
Criticism and self-criticism
Production of free, creative and inductive thinking
……
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
- Decision-making
- Working independently
- Analytical and synthetic thinking
- Critical thinking
- Problem solving

(3) SYLLABUS

- Introduction: Natural units. Review of elementary particles and interactions. (1 week)
- Experimental devices: Kinematics. Particle accelerators. Particle Detectors. (1 week)
- Symmetries in particle physics: Groups SU(2) of spin and isospin, SU(3) of flavor and color. Symmetries C και P. Representations of SU(3), classification of mesons and baryons, magnetic moments of baryons. (2 weeks)
- Relativistic Quantum Mechanics: Klein-Gordon equation. Dirac equation. Free-particle solutions. Antiparticles. Massless fermions. (2 weeks)
- Scattering: Non-relativistic scattering theory, Fermi's golden rule. Spinless electron in electromagnetic field, electron-muon scattering. Feynman diagrams, scattering amplitude, cross section. Electron with spin in electromagnetic filed, Moller scattering. (3 weeks)
- Weak interactions: Fermi's theory of β-decay. Parity violation, the Wu experiment. Unification of electromagnetic and weak interactions, W and Z bosons. Muon and pion decay. Cabibbo angle, CKM matrix. CP violation. (3 weeks)
- Neutrino physics: Neutrino masses. Neutrino oscillations. (1 week)

(4) TEACHING and LEARNING METHODS - EVALUATION

<table>
<tr><td>DELIVERY
Face-to-face, Distance learning, etc.</td><td>Face-to-face</td></tr>
<tr><td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY
Use of ICT in teaching, laboratory education, communication with students</td><td>Yes

Communication with the students using ICT (Information and Communications Technology)
Computer-aided lectures, use of Overhead Projectors
eclass platform</td></tr>
<tr><td>TEACHING METHODS
The manner and methods of teaching are described in detail.
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.

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</td><td>
<table>
<tr><th>Activity</th><th>Semester workload</th></tr>
<tr><td>Lectures</td><td>36</td></tr>
<tr><td>Exercises</td><td>16</td></tr>
<tr><td>Individual study/ problem solving/ analysis of bibliography</td><td>98</td></tr>
<tr><td>Course Total</td><td>150</td></tr>
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<tr><td>STUDENT PERFORMANCE EVALUATION
Description of the evaluation procedure

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

Specifically-defined evaluation criteria are given, and if and where they are accessible to students.</td><td>Final written exam in Greek</td></tr>
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(5) ATTACHED BIBLIOGRAPHY

- M.Peskin, Concepts of Elementary Particle Physics, Greek translation
- D. Perkins, Introduction to High Energy Physics, Greek translation
- A. Bettini: Introduction to Elementary Particle Physics, Greek translation
- B.R. Martin and G. Shaw: Particle Physics, Greek translation
- F. Halzen and A. Martin : Quarks and Leptons
- Notes by the instructors