COURSE OUTLINE

(1) GENERAL

SCHOOL	NATURAL SCIENCES		
ACADEMIC UNIT	PHYSICS DEPARTMENT		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**104**	**SEMESTER**	**7**
COURSE TITLE	INTRODUCTION TO THE QUANTUM THEORY OF FIELDS		

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**
	4	5
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).		

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Specialized Background
PREREQUISITE COURSES:	
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	http://ecourse.uoi.gr/course/view.php?id=879

(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 advanced material for understanding subatomic processes at ultra-high velocities and energies. Quantum Field Theory is the synthesis of Quantum Mechanics and Special Relativity. A large part of the course concerns the quantization of the electromagnetic field and, thus, providing a full understanding of light emission and absorption phenomena (Quantum Electrodynamics). The course curriculum includes all the mathematical background tools necessary for the quantitative description of related problems. After the successful completion of the course the student is expected to

1) Understand the basic principles of relativistic quantum processes, being able to draw qualitative conclusions based on a small number of concepts and laws
2) Describe mathematically various processes of nuclear and particle physics based on the concept of quantum fields
3) Proceed to the quantitative description of subnuclear processes setting them up mathematically and solving the fundamental equations
4) Develop an intuitive understanding of the unity of Physics at a fundamental

level through the unified description of particles and forces as quantum fields.

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…*
	…….

Search for, analysis and synthesis of data and information, with the use of the necessary technology

Working independently

Production of free, creative and inductive thinking

(3) SYLLABUS

Scalar Fields. Klein-Gordon equation. Spinor fields. Dirac equation. Quantization of the Electromagnetic field. Quantum Electrodynamics. Feynman diagrams. Wick's theorem. Scattering matrix. Calculation of scattering amplitudes in simple applications of Quantum Field Theory.

(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>Moodle system in use for communication, problem posting and quizzes</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>39</td></tr>
<tr><td>Tutorials</td><td>13</td></tr>
<tr><td>Bibliography study</td><td>40</td></tr>
<tr><td>Independent study</td><td>30</td></tr>
<tr><td>Exams</td><td>3</td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td>Course total</td><td>125</td></tr>
</table>
</td></tr>
<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>Written Exam at the end of the course based on problem solving</td></tr>
</table>

(5) ATTACHED BIBLIOGRAPHY

- *Suggested bibliography:*

M. E. Peskin and Δ. E. Schroeder “An Introduction to Quantum Field Theory”, (Frontiers in Physics)
P. Ramond “Field Theory: a modern primer”, Frontiers in Physics Series
M.Srednicki “Quantum Field Theory”, Cambridge
K. Tamvakis “Lectures in Quantum Field Theory” (2013, notes)