COURSE OUTLINE

(1) GENERAL

SCHOOL	NATURAL SCIENCES			
ACADEMIC UNIT	DEPT. OF PHYSICS			
LEVEL OF STUDIES	Graduate Course			
COURSE CODE	**M127**		**SEMESTER**	**B**
COURSE TITLE	High Energy 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**
	4	7
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*	Special background for students who continue in experimental or theoretical high energy physics.
PREREQUISITE COURSES:	Knowledge acquired from an undergraduate course in particle physics is required. Knowledge of introductory quantum field theory is very useful but not required.
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek, English
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes
COURSE WEBSITE (URL)	

(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*

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…
…….

This course aims to give graduate students in physics the necessary background in advanced concepts and techniques of particle physics today. Specifically a student will:

- Learn the general concepts of Particle Physics theory which have been used to built the Standard model of Physics (Global and Local symmetries, Spontaneous symmetry breaking, Higgs mechanism and giving mass to vector bosons and fermions).

- Understand well the original publications to the level that she/he can give class presentations about them.
- The details of the Electroweak Lagrangian term by term as well as the Feynman rules which originate from terms of the Lagrangian. The Higgs production and decay terms and diagrams.
- The phenomenology of the superconductivity theory and the relation of it to the Higgs mechanism.
- The physics of interaction of radiation with matter.
- Key experimental techniques for particle identification and measurement (Calorimeters, Muon detectors, Silicon detectors, etc).
- The key experiments and measurements which were cornerstones in the development of the standard model as we know it today (muon decay, parity violation, neutrino helicity, CP violation, Neutrino measurements, W/Z discovery, the discovery of the Higgs.

(3) SYLLABUS

This is an advanced particle physics course which introduces graduate and PhD students to the theoretical concepts and experiments which led to the development of the Standard Model of Particle Physics. The topics covered are:

- Global Symmetries
- Chiral Symmetry in the Strong Interactions
- Noether Theorem, currents and charges
- Current Algebra
- Global symmetry and the Ground State
- Spontaneous Symmetry Breaking
- Goldstone Theorem and proofs
- The Sigma Model
- Abelian and Non-Abelian Local Gauge Symmetries, Gauge Fixing
- Higgs Mechanism
- The Standard Model of Electroweak Interactions
- Superconductivity, Copper Pairs, Meissner Effect, London Equations
- Ginzburg Landau Phenomenology
- Interaction of radiation with matter
- Calorimeters
- Tracking detectors
- Triggering techniques
- Experiments and results which influenced the evolution of High Energy Physics.

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face to face teaching (Class lectures)
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Blackboard and chalk
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*	see table below
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.*	Four sets of homework, in class presentations of publications related to the course or project work. Alternatively a final written exam can replace all above.

Activity	***Semester workload***
Lectures	52 Hours
Homework	60 Hours
Paper Presentations or Project work	60 Hours
	172 Hours

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography: Gauge Theory of Elementary Particle Physics, Cheng and Lee
- Related academic journals: All journals which publish articles in experimental and theoretical particle physics such as Physical Review Letters, Physics Letters, Nuclear Physics, Physical Review D, European Journal of Physics, Nuclear Instrumentation and Methods etc.