COURSE OUTLINE

(1) GENERAL

SCHOOL	NATURAL SCIENCES		
ACADEMIC UNIT	DEPARTMENT OF PHYSICS		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**107**	**SEMESTER**	**6,8**
COURSE TITLE	GROUP THEORY		

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	4
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
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=791

(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 objective of this course is the students to acquire knowledge and skills in order to recognize the geometrical and dynamical symmetries of the physical problems and to use group theory (mainly the theory of representations) in their comprehension and solution. The course offers to the students advanced knowledge of the theory of discrete and continuous groups which are useful tools of simplification (reduction of the dimensionality of matrices, avoidance of complicated calculations, reduction of the number of equations due to the invariance under certain transformations) of problems with geometrical, dynamical and approximate symmetry. The students will become familiar with the general methodology and the applications of the above in order to solve problems of theoretical physics in Quantum Theory and its applications in atomic-nuclear systems, physics of elementary particles and astro-particle physics. Particularly, after the successful completion of the course, the student will be able to:

- Discover/describe the elements of abstract groups of finite rank as well as elements of groups of symmetry transformations.
- Find the conjugate classes, subgroups and co-groups (left and right) of a group.

- Find the regular, the reducible and irreducible representations of a group and, by applying the relevant theorems and the direct sum/product of matrices, construct new representations.
- Use the irreducible representations and their characters (as well as the orthogonality theorems) and apply the representation theory to physical examples of discrete and finite groups.
- Construct groups and Lie algebras and apply them to groups that are found in atomic and nuclear physics, in particle physics and in modern gauge theories.
- Find the generators of a continuous group and apply them in various physical problems.

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…
…….

Search for, analysis and synthesis of data and information, with the use of the necessary technology
Decision-making
Working independently
Criticism and self-criticism
Production of free, creative and inductive thinking

(3) SYLLABUS

Elements of abstract groups of finite rank. Symmetry transformation groups. Conjugate classes. The symmetric group. Representations. Irreducible representations. Characters. Schur lemmas. Reduction of representations. Wigner's theorem. Continuous groups and their representations. Lie groups and algebras. The O(2), O(3), SU(2), SU(n), O(n), Sp(n) groups. Casimir operators. Applications.

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face-to-face
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Use of the course web page on http://ecourse.uoi.gr to post notes, exercise sheets and to communicate with the students
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-*	

Activity	*Semester workload*
Lectures	39
Problem Solving	13
Study of Bibliography	32
Independent Study	13
Exams	3

directed study according to the principles of the ECTS		
	Course total	***100***
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.*	End-of-semester written exams (3 hours)	

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

1. Βέργαδος Ι. ΘΕΩΡΙΑ ΟΜΑΔΩΝ, Μέρος Α και Β, Εκδόσεις Συμεών (1991).
2. J.F. Cornwell, Group theory in physics, Vol. I & II, Academic press (1984).
3. M. Hammermesh, Group theory, Addison, Wesley, Reading Mass (1964).
4. M. Hammermesh, Group Theory and Its Application to Physical Problems, Dover publications (1962).
5. J.W. Leach, D.W. Newman, How to use groups, Methuen, London (1969).
6. T. Inui, Y. Tanabe, Y. Onodera, Group Theory and Its Applications in Physics, Springer (1996).
7. L.M. Falicov, Group theory and its applications, Chicago University Press (1967).