COURSE OUTLINE

(1) GENERAL

SCHOOL	SCHOOL OF SCIENCES		
ACADEMIC UNIT	PHYSICS DEPARTMENT		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**113**	**SEMESTER**	**7**
COURSE TITLE	MATHEMATICS AND PHYSICS BY COMPUTERS		

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**
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*	Specialised general knowledge/skills development
PREREQUISITE COURSES:	
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes
COURSE WEBSITE (URL)	http://ecourse.uoi.gr/enrol/index.php?id=1029

(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 students with advanced knowledge and skills in the use of specialised symbolic calculation software, with emphasis on open source software, with the aim of solving physics and mathematics problems with computers. After successful completion of this course the student is expected to be able to use the appropriate software in order to:

- **Plot functions and data**
- **Solve analytically and numerically linear and nonlinear systems of equations**
- **Calculate analytically and numerically derivatives and integrals of functions of one or several variables**
- **Solve analytically and numerically differential equations**
- **Analyse data and calculate quantities as the mean, median and standard deviation and fit data to a curve**
- **Create animations and simulations of the evolution of physical systems**

- **Write programs combining the above techniques to solve problems in Mathematics and Physics as visualising equipotential surfaces and electric field lines, calculating Fourier series representations, solving equations of motion of mechanical systems, finding extrema of functions, finding eigenvalues and eigenvectors and solving Diophantic equations**
- **Combine the above techniques in creating graphical visualisations and simulations that are useful in physics and mathematics teaching**

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.**
- **Working in an interdisciplinary environment.**

(3) SYLLABUS

Introduction: Historical Elements, Symbolic Calculations and Related Software. Open Source Software – The SAGEMATH project. Basic Concepts: Simple algebraic and numerical calculations, functions, derivatives, integrals, roots of equations. Graphic representations: Plotting of functions in two and three dimensions, plotting data, graphic representation of vector fields, animation. Complex Problems: Linear Algebra, Equations, Individual Functions, Rows, Differential Equations, Numerical Calculations. Applications in Mathematics and Physics.

(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*	**Extensive use of the learning management system MOODLE in delivering course content (as lecture notes, problems and solutions) and submitting solutions to assignments.**
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*	

Activity	*Semester workload*
Lectures	13
Laboratory practice	39

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*	Study and analysis of bibliography	19
	Essay writing (Problem solving)	26
	Exams	3
	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.*	Essay writing (40%), Final examination (60%). Both involve the solution of problems using the appropriate software.	

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- Michael O'Sullivan, David Monarres, SSDU SAGE http://www-rohan.sdsu.edu/~mosulliv/Teaching/sdsu-sage-tutorial/index.html
- Ted Kosan, SAGE For Newbies, February, 2008, https://www.uam.es/personal_pdi/ciencias/pangulo/laboratorio/sage_for_newbies_v1.23.pdf
- Gregory V. Bard, Sage for Undergraduates, American Mathematical Society, 2014.
- David Joyner and Marshall Hampton. Introduction to Differential Equations Using Sage, Johns Hopkins University Press, 2012.
- A. Casamayou, N. Cohen, G. Connan, T. Dumont, L. Fousse, F. Maltey, M. Meulien, M. Mezzarobba, C. Pernet, N. M. Thiéry, P. Zimmermann , Calcul mathématique avec Sage, http://sagebook.gforge.inria.fr/
- Robert A. Beezer, A Sage primer for linear algebra, http://linear.ups.edu/html/fcla.html και http://linear.ups.edu/download/fcla-3.40-sage-6.4-primer.pdf
- Sage Tutorial, The SAGE development team, http://www.sagemath.org/pdf/en/tutorial/SageTutorial.pdf