Εκτύπωση Κλείσιμο

Course Details

Course Department:	Department of Physics
Course Code:	PHY 145
Course Title:	Computational Methods in Physic
Number of ECTS:	6
Level of Course:	1st Cycle (Bachelor's Degree)
Year of Study (if applicable):	1
Semester/Trimester when the Course Unit is Delivered:	Spring Semester
Name of Lecturer(s):	Haralambos Panagopoulos
Lectures/Week:	1 (1.5 hours per lecture)
Laboratories/week:	1 (3.5 hours per lecture)
Tutorials/Week:	--
Course Purpose and Objectives:	Familiarization with computer languages for numerical calculations. In-depth focus on integrated methods for the quantitative investigation of a wide spectrum of physical phenomena, including: modeling, construction of algorithms, production of numerical results, statistical analysis and graphics representation.
Learning Outcomes:	By the end of the course students are expected to: • Be familiar with computer environments and applications in the public domain which are of wide use in academia, such as: Linux operating system, Emacs word processor, Gnuplot graphics software. • Operate programming languages of relatively low level (C or Fortran) and high level (Mathematica) for quantitative investigation of physical phenomena. • Construct computer programs applicable to a wide spectrum of physical problems, involving: Finding solutions to algebraic equations, Solving differential equations, Time evolution of physical systems, Use of matrices and vectors, Numerical integration, Randomness. • Design algorithms applicable to more complex physical problems. • Create programs for the statistical analysis of their results. • Represent their results graphically in a variety of styles. • Assess the efficiency of alternative computer programs using theoretical and empirical arguments. • Select optimized algorithms for application to specific problems, according to a spectrum of criteria: Efficiency, Numerical error estimates, Use of memory, Modularity, Flexibility in use, User friendliness, etc.
Prerequisites:	PHY140, MAS018
Co-requisites:	PHY111, MAS019
Course Content:	Introduction: The Linux operating system, Emacs editor, plotting, computer implementation of numbers, basic commands of the C/Fortran programming languages.

	Ordinary differential equations: Numerical differentiation, Euler method, Runge-Kutta method. Applications to simple physical systems: planetary orbits, electronic circuits. Algebraic equations: Bisection method, Newton-Raphson algorithm. Systems of linear equations: Inverse matrices, matrix diagonalization. Applications in Classical Mechanics. Data analysis: Probability distributions, least squares method, fits. Numerical integration: Simpson method, Gaussian quadrature, multiple integrals in Physics. Deterministic randomness: Random number generators, simple simulations, Monte Carlo evaluation of integrals. High level programming languages: Introduction to the program Mathematica, symbolic computations, numerical and analytical evaluations of integrals and equations. Applications in Physics.
Teaching Methodology:	Lectures consist of: Brief review of previous lectures, introduction to new concepts with reference to their potential applications, discussion and questions by the instructor and the students, exercises and applications of increasing difficulty, summary and conclusions, identification of points for reflection and discussion during the following lecture. A large part of the lecture material is projected on a screen via a PC. This material, consisting of descriptions, algorithms, graphs, etc., is sent to students beforehand. During the lecture extensive use is made of the blackboard. Certain examples, often stemming from students' questions, are addressed interactively on the screen: appropriate algorithms are constructed and put to execution, and results are represented graphically, with the active participation of students. Each 4-hour lab corresponds to the preceeding lecture. Students work in teams under the constant supervision of the instructor and two teaching assistants. By applying the procedures and techniques of the lecture, each student must individually construct optimized algorithms to solve 2-3 physical problems, produce numerical results, and compose a laboratory report including their computer code, results, graphs and conclusions. For the 2 homework sets handed out during the semester, students are given one week's time to address problems which require critical thinking and a synthesis of approaches. Students are encouraged to collaborate in their homeworks; however, each student much prepare their own write-up of the answers. Past homeworks, laboratory exercises and exams, along with suggested solution sets and laboratory reports, are uploaded on the course's website, and

	discussed in preparatory lectures and recitations before the final exam.
Bibliography:	The following suggested bibliography is not compulsory. All necessary course notes are uploaded to the course's webpage. N. J. Giordano and H. Nakanishi, Computational Physics, Prentice Hall (2006) A. Garcia, Numerical Methods for Physics, CreateSpace Independent Publishing Platform (2015). H. Gould, J. Tobochnik, W. Christian, Introduction to Computer Simulation Methods, Addison-Wesley (2006). S. Trachanas, Mathematica and Applications, Crete University Press (2004) (in greek). W. Press, S. Teukolsky, T. Vetterling and B. Flannery, Numerical Recipes, Cambridge University Press (2007).
Assessment:	• Homework sets: 10% • Laboratory reports: 15% • Midterm exam: 25% • Final exam: 50%
Language of Instruction:	Greek Part of the bibliography is in English.
Delivery Mode:	Face-To-Face
Work Placement(s):	Not Applicable