University of Jordan **Department of Physics**	**Software Packages in Physics** **0332481**	**Second Semester** **2004-2005**

Tentative Course Outline

Instructor: Usama al-Binni, Accelerator building, room 303, email: **u.binni@ju.edu.jo**.

Teaching Assistant: Hatem Babaa

Lab: Physics Computer lab (Physics building, room 220). This will also be the place where you will attend theoretical lectures.

Course Website: The following is a temporary address: http://www.geocities.com/uabinni/

Recommended References and Resources:

- Wolfram, S. *The Mathematica Book* (online help browser).
- Tam, P. T. 1997. *A Physicist's Guide to Mathematica*, Academic Press, San-Diego.
- Lecture notes and other material, to be downloaded from the course's website.
- The internet is filled with relevant material, but we particularly recommend following the contents of Wolfram's website. Links to other resources on the internet will be posted on the course's website with time.

Introduction: The twentieth century has witnessed a huge explosion in pure and applied knowledge. Computers, as we know them today, are less than one century old, but they have become so useful, that they've entered almost every nook and cranny in our life. Physicists all over the world use computers in all sorts of applications; to help solve complex equations, to simulate physical phenomena, and to do much more. Knowledge in using computers is, therefore, an indispensable asset that a physicist needs to have. This course tries to fill at least part of a gap that our students have in this regard.

Course Description: This course is basically intended to provide the student of physics with the tools necessary to use a personal computer in tackling physical problems. This is an interdisciplinary activity that requires the student to be knowledgeable in the physics and mathematics of the problem on the one hand, and in the computational and programming techniques necessary to implement the solution. Therefore, the course is divided into a theoretical part delivered in the form of one weekly lecture dedicated to giving students a glimpse of the subject-matter of computational physics and some related issues, and a practical part in the form of a 3-hour weekly lab session where students learn some of the practical aspects of solving a problem by computer, and will be required to solve specific problems from various physical disciplines.

Goals:

- To acquaint students with the major uses of computers in doing physics.
- To afford the students skills that enable them to use computer software to assist in solving physical problems, with emphasis on the *Mathematica* system.
- To acquaint students with the basics of computational physics and the use of basic numerical techniques.

Objectives: Upon a successful completion of this course, a student should be able to do the following:

- Have a general acquaintance with basic computational and numerical techniques and their pertinence on physical research.
- Be able to translate a physical problem into one that is solvable by a computer.
- To have the practical and theoretical knowledge necessary to use specific computer systems to implement the steps of the solution; and in particular to use the programming language and facilities provided by the *Mathematica* system to do so.
- Be acquainted with the general scene of scientific software available and the modern trends in scientific software industry.

Software: The practical part of the course will principally be centered around using the *Mathematica* system, but other systems will also be visited.

Assumed Knowledge and Required Skills: Even though, officially, there are no prerequisites for taking this course, it is strongly recommended that you have good acquaintance with operating a Windows-run computer, and a previous knowledge in some programming language is a big plus, otherwise you will have to put extra effort to compensate. But this is not a course in computers as such; it's about the possible ways a physicist can use a computer to help him or her do his or her work. The lab part of this course poses problems that will often take the form of little projects, so before you actually get to the computer part, you'll have to understand the physics and the mathematics involved, to formulate a method of solution, and then to carry out the solution. The problems will come from all sorts of physical disciplines, and as a senior-year student you are supposed to be well prepared for research work, so, you need to have the resourcefulness of a researcher, and perhaps a touch of creativity, and this draws somewhat from the knowledge and experience you have amassed in your 3 or 4 years of studying physics so far. You don't need, however, to be well versed in everything, and you are allowed to consult with whatever references you like, provided you respect the right of authorship of those whose work you consult.

Lab Work Format: Each week, you will attend a 3-hour lab and a 1-hour lecture. Before you enter the lab, you are expected to have read the lab sheet, if it had been posted on the web by then. In the lab, you will be introduced to suggested computer skills you are likely to need in order to solve the problem posed in the lab sheet, you are not expected however to solve the problem within these three hours, rather, you will have until next week the same time to hand in your results in the form of a report, whose specifications are to be found on the course's website.

Preparation and Attendance: We will not be adhering in this course to a fixed textbook, but lab sheets will be available at the course's website for download prior to each lab session. Also, lecture notes will be made available gradually. Before a lab session it is highly recommended that you read the lab sheet and try to understand any code given in it. This is for your own good; if you come to the lab prepared, you will take less time in mastering and employing the new information you will be given, and it will therefore take you less time to hand in your results. Your attendance of both the theoretical and practical parts is mandatory, an absence from the lab will cost you **20%** of that lab's grade, and an absence from the weekly lecture will cost you **2%** discounted from your overall grade. These discounts will be cancelled in case an official excuse is presented to your instructor, and provided you do not exceed the number of absences allowed by University regulations.

Academic Honesty: As mature senior-year students, it is presumed that you all work independently of your colleagues, and that you respect copyrights and do not recycle each others' work or work of previous year students. In parts specified by the instructor you could be allowed to collaborate with a partner, but even then your work should be distinct, and the fruit of your own efforts. **No plagiarism is**

tolerated; and any such activity if detected will be severely dealt with. It is ok to quote from a source (book, paper, internet… *etc.*) as long as you document that source clearly (*see the section on writing in the website*), and that you contribute some of your original ideas to what you present, and not just a regurgitated version of someone else's work!

Timetable and Schedule: At present, there is no fixed schedule for the lab sessions. Each week's lab sheet(s) will be posted on the web on that same week, and you will be given a total of 8 to 10 sheets to work on during the course.

Exams and Projects:

- *Mid-term exam*, which will contain part or all of the following: A practical exam, a theoretical exam, and a seminar.
- *Final exam*, will have all of the following parts: practical, theoretical, and project.

A Tentative Grading System:

- Lab work and assignments are given **40%** weight of the total grade, but a fraction of this is reserved for activity and participation. The results of your lab work are expected to be handed in within one week after the lab sheet is posted on the web, each day you are overdue will cost you **10%** of the grade you should have taken the previous day. If you are a whole week overdue, you forfeit your right to the mark of that lab.
- The mid-term exam will weigh **20%** of the overall grade.
- The remaining **40%** will be divided between the final exam and a project.
- Extra-credit is encouraged, and will be evaluated as an additional **5%** on your total grade. You can get extra credit by doing extra work, or by performing or suggesting insightful modification on the original ideas you are treating.