Techniques of Physics

Demonstrators

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Introduction

The aim of this course is to develop the use of computers in investigating practical physics situations. Little or no programming knowledge is needed as emphasis will be placed on learning to use CAD packages to simplify the solution of common physics problems. The course is based on Mathcad, a mathematical package which will be useful for many of the projects later in the year.

The course is arranged as sixteen sessions of two hours during the first eight weeks of term and will take place in the P5 computing laboratory. This area is equipped with 20 Pentium 133 PCs running Windows 95. In addition to the 4 hours of weekly timetabled sessions with demonstrators the Course 4 students have absolute priority for using these computers between 4 and 6 pm on each Wednesday and Friday throughout the first semester. You are expected to spend up to 5 hours per week outside timetabled classes working on your solutions.

Timetable of Sessions

The work is divided into five topics, each accompanied by a worksheet with several problems to solve. The topics, and their weighting in the final marks, are listed below:

1. Introduction to Mathcad — Solving simple problems to learn the basic techniques. The following weeks will use this knowledge and extend it to more complex problems (*0%*).

2. Oscillations and Waves in various systems — including wave-packets and musical instruments (*28%*).

3. Solutions to Schroedinger's Equation — particle wave propagation, potential wells, and the Hydrogen atom (*16%*).

4. Digital Signal Processing — Digital Filters and the Fast Fourier Transform (*28%*).

5. Data Analysis — Statistics, Monte Carlo methods and fitting techniques (*28%*).

A detailed timetable including dates for each exercise to be handed in is given in Table 1.

Date	**Week**	**Worksheet**	**Part**	**Hand-in Date**
Introduction				
Tuesday 28^{th} September	1	1	I	Tuesday
Thursday 30^{th} September	1	1	II	5^{th} October
Classical Waves				
Tuesday 5^{th} October	2	2	I	
Thursday 7^{th} October	2	2	II	
Tuesday 12^{th} October	3	2	III	Tuesday
Thursday 14^{th} October	3	2	IV	19^{th} October
Quantum Mechanics				
Tuesday 19^{th} October	4	3	I	Tuesday
Thursday 21^{st} October	4	3	II	26^{th} October
Digital Signal Processing				
Tuesday 26^{th} October	5	4	I	
Thursday 28^{th} October	5	4	II	
Tuesday 2^{nd} November	6	4	III	Tuesday
Thursday 4^{th} November	6	4	IV	9^{th} November
Data Analysis				
Tuesday 9^{th} November	7	5	I	
Thursday 11^{th} November	7	5	II	
Tuesday 16^{th} November	8	5	III	Tuesday
Thursday 18^{th} November	8	5	IV	23^{rd} November

Table 1: Course Timetable.

Student division into groups

Two demonstrators will be in the computer laboratory between 9am and 1pm on Tuesdays and Thursdays. The lab has limited space, so students are requested to stick as strictly as possible to their assigned hours during the demonstrator sessions.

Most students have been assigned two hours on Tuesdays and two on Thursdays. However, due to timetabling constraints, the PWE students will have to do their four hours entirely on the Tuesday session. The division of the students into groups is shown in Table 2.

Assessment

The course is structured as a laboratory course and will be continually assessed. Your solutions for the first five worksheets will be in the form of the printed Mathcad output. Mathcad allows suitable annotation so that a reader can easily follow the logic, and notes can be made within the document to answer questions posed in the worksheets. Adding notes by hand to a document is also acceptable as long as the hand-writing is legible.

The weight given to each session was indicated above. The first session, which is an introduction to Mathcad, will not be formally assessed although you will be required to hand in your solutions, but it will have no influence on the final mark. This is really just so that we can see how you are progressing and give some pointers. There are also questions marked as **optional** on the worksheets. You do not have to attempt these and there will be **no** extra marks given to those that do attempt them. They are purely there for your interest if you have any spare time.

In general, for the Mathcad work, about 60% of the marks will be awarded for writing a working document, and 40% will be for additional answers to questions in the text. These questions will be highlighted in the text, and in general should be answerable by brief, one or two line sentences — you should definitely not write an essay on each one. The presentation itself does not have to be very neat — it is actually quite difficult to produce a beautiful document from Mathcad. However, you should present enough information in order that someone reading the document from scratch can understand each step. For example, one important principle to follow is that you should never introduce a new variable without explaining what that variable represents:

```
Let the length of a piece of string be     L
Let the answer be                          a
                                           a := 42
```

Each assessed segment is marked by a single member of the team with Dr. Watkins monitoring and ensuring consistency between each member.

Techniques of Physics: Groups	
Group 1: Tuesday 0900–1100,Thursday 1100–1300	
Bell, Paul	PHY
Brocano, A	ERA
Bull, Jacqueline	PHY
Bull, Stephen	PHY
Butler, Adam	PHY
Faulkner, Edmund	PHY
George, Sarah	PHY
Guest, Ian	PWA
Hartwell, Joanna	PWA
Lowe, Steven	PWA
Mapson-Menard, H	PWA
McCarty, Bernard	PWA
Osmond, John	PWA
Tahir, Miran	PWA
Tallboys, Dean	PWA
Tanner, John	PWA
Wan, Kam	PWA
Willman, David	PWA
Wilson, Sarah	PWA
Group 2: Tuesday 1100–1300,Thursday 0900–1100	
Attwood, David	PHY
Bhatt, Darmesh	PHY
Bolton, Reuben	PHY
Casperson, Dominic	PHY
Chapman, Paul	PHY
Fowler, John	PHY
Hillier, David	PHY
Hoeink, V	ERA
Holt, John	PHY
Horrocks, Frances	PHY
Hussain, Ifran	PHY
Jones, Benjamin	PHY
Keogh, James	PHY
Macdonald, Paul	PHY
Matthews, Paul	PHY
Mitchell, Alexander	PHY
Thayer, Hazel	PHY
Twyman, David	PHY
Uzur, Dejan	PHY
Woehrling, Ethan	PHY
Group C: Tuesday 0900–1100, Tuesday 1100–1300	
Jones, Lee	PWE

Table 2: Student Groups.