Preface

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Background and context

Two series of eLearning modules have been developed to support student learning in their study of mechanics in Year One.

A. The lectures in the course PHYS 1111A University Physics I: *Introduction to Mechanics, Fluids and Waves* have been recorded, together with the presentation slides, and organized into about 140 micro-modules. This part is more directly tied to the particular course, and is essentially the replica of the class offering in one term, with a total length of about 960 minutes.

B. The present series consists of supplementary material on a selection of topics. Although there is an overlap with the recorded lectures, the purpose is slightly different, as explained below. The modules in this series are more stand-alone, and would be useful to students enrolled in other courses. The series as presented here is work-in-progress, and it is the intention to gradually add to these micro-modules.

The two series taken together would enable students to study more at their own pace, for example by going through a particular segment of the material again after the lecture. There is also the possibility that some parts and/or some sections of the class can be taught in a flipped classroom format.

Choice of material

The present series, in Part B, contains topics that satisfy one or more of the following conditions.

1. **Filling some initial gaps**. Increasingly, students taking freshman physics now come with a variety of backgrounds. Thus there are differences in the prior preparation, especially in the mathematical tools needed, and it would be too late to wait for these topics to be taught in the calculus course taken in parallel. Very often these gaps are just small fragments here and there, and can be filled with relatively little effort.

2. **Extending some topics**. Inevitably, because of the time available in class, and the varying abilities of students and their different interests, the lectures can only cover the mainstream topics. Some students would find it interesting and challenging to learn more, in many cases straightforward extensions of the lectures.

3. **More systematic formalism**. The nature of any physics course is to bring a variety of interesting physical phenomena into a coherent framework. But for the first university-level course, the lectures must keep the formalism simple, often limited to special cases, so that, for the first exposure to the subject, mathematics does not overwhelm the ideas. However, the stronger students, after very quickly mastering the ideas, would hunger for something more systematic and more general.

Topics such as these, in all cases catering to different individual needs and paces of learning, are most suitable for an eLearning mode.

Stand-alone topics

These topics do not necessarily form a sequence, and modules can be studied very much (but not completely) on a stand-alone basis. We encourage students to work through such selections as they find useful and interesting.

Relationship with other learning activities

There is some danger that this series of modules, if regarded in isolation, would convey a sense of physics that is far too formalistic and mathematical. To drive home this point, it may be useful to suggest an outline of different learning activities.

1. One always starts with phenomena, for example a bob bouncing up and down at the end of a spring. These experiences come from daily life, from the laboratory, from class demonstrations (including videos of demonstrations) and (perhaps less effectively) through descriptions contained in textbooks. In many cases, the phenomena should already be familiar, and already placed into a cognitive framework, through high school science classes.

2. Then one builds simple models, emphasizing a mental image and using the minimum of mathematics. For example, the up-and-down motion of the bob is described as the projection onto one axis of a circular motion, and simple formulas such as $A\cos\omega t$ are introduced. Lectures are the most effective medium for this part of learning.

3. Next one needs to build up a more systematic, more general and more rigorous theory; in the case of oscillators, this might include the use of complex numbers $\exp(i\omega t)$ to deal with damping and resonance. Typically this step, in the case of mechanics, is not completed until the second or even third course in this domain. The present modules represent an attempt to fill gaps in this segment of learning at a level that might be useful for Year One students.

4. Finally, to give flesh and blood to the theory, one needs to learn about all the applications. Good textbooks are often the best medium for this segment of learning.

In this schema, the present modules address only (part of) the third component, and in some cases the second component. If less emphasis is given to the underlying phenomena and the physical ideas, it is because they are to be dealt with elsewhere, through media that are more effective for the respective purposes. These modules (and those in Part A) are not designed to replace laboratories, demonstrations and textbooks, but to supplement them. In fact, one danger of eLearning, and of teachers preparing detailed presentation slides, is that students then do not read the textbooks. We hope that this does not happen.

Lecture notes

Precisely for the reasons outlined above, we would be disappointed if any initiative in eLearning were to have the unintended and pernicious effect of discouraging students from serious reading. Especially for the more formalistic side of physics (as opposed to introduction to phenomena), a depth of understanding and an attention to detail are essential, so it is not enough to simply listen to a presentation. Thus we have also prepared lecture notes for each topic, structured almost like chapters in a book. We hope that students will work through these step by step. Though they are closely parallel to the narrated modules, the lecture notes contain a few more worked Examples and many more Problems for students.

Feedback

We welcome feedback on all these modules: where concepts may need more explanation, where additional topics may be desirable. In an endeavour of this sort, it is inevitable that there will be errors, typographical errors in the text or slips of the tongue in the narration. We hope these are rare and minor, and in most cases can be understood and implicitly corrected by the audience. But in any case, we would like to hear about them for the record, so that they can be corrected in the next edition.

Please send comments via the link provided.

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