Course Analysis for Classical Mechanics in FYSA12, VT 2020

Course responsible: Ruth Pöttgen

Other teachers: Elizabeth Blackburn

Number of students registered: 70 (including students that needed only individual elements/labs)

Number of replies to survey: 34

Course Representatives:
Leana Cazorla
Zebaztian Pålsson

Students taking the exam: 37

Grades: U: 13, G: 15, VG: 9

Analysis

A) Summary of Course Evaluations

A report summary is attached at the end of this document.

Overall, the respondents indicated they were satisfied with the course quality (mean score 4.3 of 6, standard deviation: 1.3).

The lectures were attended at least semi-regularly by about 70% of the respondents, attendance to the exercise sessions was much lower, only about 30% attended somewhat regularly.
There were 31 written responses commenting on the lectures. Of these, 19 indicated that the lectures were good. The use of clickers (6) during the **lectures** as well as the demonstrations (3) were clearly appreciated, and the lectures were perceived as well structured (3). The feedback on speed and content of the lectures was very broad: while some found the course too basic and slow-paced, others deemed it adequate, and some felt it was going too fast (especially towards the end). Some respondents commented that the early starting time (8:15) was not optimal, others said that a 4h lecture block was too long. There were a few suggestions to include more examples on problem solving in the lectures. Two respondents suggested to record lectures and make them available for later watching. One respondent suggested to make some time for the teachers to talk about their own research and typical work.

Feedback on the **exercise sessions** was also wide-spread, ranging from “pointless" to “perfect”. In general, those that attended the exercises, found them useful. Suggestions were made to include more demonstrations of solutions by the tutors and focus the exercises more on exam-like questions. One suggestion was also made that the exercise classes should be switched with the 10-12 lecture block to break up the timetable. Very positive feedback was given on the hand-in problem sheets: a majority really appreciated them for the opportunity to test their understanding and prepare for the exam, get feedback on how they were doing — and also for the bonus on the exam. The first three problem sheets were appreciated more than the last two. Criticisms that were raised were that no written solutions were supplied, they required too much work/time, they were not close enough to the exam questions, the bonus credit was not sufficient, the bonus credit puts better students at a disadvantage, hand-in via canvas was not possible.

About 40% indicate they did more or less all of the required work (in terms of preparations, reading etc.), 50% indicate they could have done some more, while about 12% did rather little. The additional hours spent studying per week vary from 0 to 30, with an average of 12.5 hours.

There were no particularly strong opinions on the **book**. There were 30 written responses. 18 respondents thought the book was good. Other comments were that it was good that the lectures followed the book (3) and that the extended examples in the book were good (2). The primary criticism of the book was that it was longwinded (4). Several respondents said that they used other tools/books, and suggested that a second recommendation to give alternate explanations would be helpful. One person said that the Global Edition would be preferred. Another recommended Klepper and Kolenkow.

The main feedback on the **laboratory exercises** was that the deadlines for the report writing were too short, causing a lot of stress, and that the criteria applied for the report grading were not clear enough and varied too much between labs/supervisors. Opinions on the content of the labs varied a lot, from boring to really interesting and useful. It was pointed out that the lab manuals could be clearer. Another comment was that learning how to write reports in Latex was an additional stress factor for several students, in particular in combination with the short deadlines. The lab space was criticised for M4. There is also a serious critique of the way the labs are structured, with a call to provide the manual in advance, along with more detailed explanation of the instruments, communicated by lecture in advance.

Essentially everybody felt they had a sufficient level of pre-knowledge to master the course; and a third of the respondents agree strongly that their understanding of the subject has increased as a result of taking the course, another 45% agree to a slightly lesser extent. A few respondents disagree. A recurring comment on the exam was that it was harder than expected, but generally ok and adequate for university level. Specific complaints were:

- too much maths required
- the problems to be solved were too general and not specific
- the wording was too complicated
- they were school-level questions
- questions from (presumably like) the book would be better
- more shorter questions, covering more content, would be better
- the course material was not uniformly covered by the questions
- longer than previous examinations
- the questions were very different to previous exams

Regarding the atmosphere in the course, there is an overall strong agreement that everybody got a chance to get heard and listened to, and a majority also agrees to some extent that students' different learning styles and experiences were considered.

Most respondents (close to 70%) rate their constructive contributions as medium, about 20% feel more strongly they contributed constructively.

B) Comments/reflections from the teachers

The evaluation results were discussed together with the course representatives. This discussion was helpful in interpreting the outcome of the evaluation and completing the picture.

First of all, it is good to see that the overall atmosphere of the course was evaluated positively and the teachers were perceived as engaged, approachable and helpful. We were impressed with the level of engagement of the students.

The evaluation survey and the discussions with the course representatives reveal some areas were improvements clearly should and can be made. This holds in particular for the laboratory part, but also the exercises and lectures still have room for improvements (see Section D for some more concrete thoughts). Several of the potential changes are, however, not exclusively related to the mechanics course, but require coordination between the different modules of the course.

We agree that certain parts at the end of the course (elasticity/fluid mechanics) were rushed. This was in part due to these being covered to this extent in the course for the first time. Now, we'll have a better time estimate for the future.

We felt that the large blocks of lectures were not as bad as we feared in the beginning, but we both think that there is a dip in the performance of us lecturers after two hours. The demonstrations helped with making the long blocks more 'bearable' for everyone, and they went better than we initially expected — also thanks to a lot of help from Stanley Micklavzina.

The suggestion to have the lecturers introduce their research and day-to-day work is an interesting one.

We gave the students a pre-test, which was quite helpful, but then we didn't really incorporate that into the actual teaching.

Something that strikes us as odd with the timetabling of the course is that there are 12h of lectures reserved for repetition before the exam, i.e. about ⅕ of all the lecture time in the course! (In addition to 6 hours of exercise sessions.) This seems a little excessive, and usually attendance is rather low on these days, presumably because students prefer other means of preparing for the exam. Thus, it would seem that this lecture time could be better used elsewhere. However, given the tight overall time constraints, it is not obvious how to move things around.

The comments on the exam were in general helpful and specific. We note that there is no requirement for the exam to touch every aspect of the course.

A number of the written comments indicate that the purpose and value of laboratory work has not been clearly communicated to the students. For example, there were comments stating that the labs took up too much time and that the theoretical content could have been communicated much more efficiently. This is clearly true if the purpose is just to learn about, for example, big G, as opposed to learning about experimental physics, using mechanics as the means. In addition, there were a number of comments indicating that the work was tedious and robotic. Again, this indicates that the reasons and methods behind experimental work are not well understood by the students, or the difference between precision and accuracy. This should presumably be covered better in the intro lab section. It may also be a good idea to give the students a bit more leeway to improve their experimental methodology, where possible.

The comment about the manual in advance is reasonable. The use of a lecture to talk about the instruments is very limited.

Something that becomes very clear from the survey responses is the heterogeneity of the student group and their different expectations from the course. This is reflected for example in the wide spread of views on the course content and level of difficulty or the usefulness of exercise sessions. It is likely also (part of) the reason for low attendance to some parts of the course or the different perception of how much the understanding of the subject has increased. As this course will always have a very mixed group of students with widely varying backgrounds, this is probably something that we will not be able to address fully, but some thoughts are included in Section D.

EB in particular wants to spend some more time on running through graphical representations.

C) Evaluation of changes since the course was given last

The main changes to this course (compared to VT19), were the following:

- The labs were split over two periods, instead of several weeks en bloc.
- A report had to be written for each lab, instead of only two (and grading based on lab books for the other labs).
- The SI sessions were replaced by exercise sessions.
- Hand-in problem sheets with a bonus for the exam were introduced.
- A much larger number of demonstrations was incorporated in the lectures.
- We had a larger fraction of days split into 2h Mechanics + 2h EM, instead of 4h on the same topic.

The split of the lab period in general seems to have been positive, but it does pose additional challenges in the scheduling and aligning labs and material covered in the lectures. It did apparently not help with reducing the stress from writing the lab reports, so having compared the two approaches now, it seems preferable to go

back to the scheme with only two reports to be written (with a slightly longer deadline), but to keep the split into two periods for now.

The demonstrations and hand-ins received very positive feedback, so those we'll keep, with some small modifications. There was no strong preference expressed by the students for either the 2h+2h or 4h lecture scheme, but in general 4h of lecture were often perceived as too long to stay focussed.

The exercise sessions were evaluated more positively than the SI sessions last year, but attendance is still low and many students seem to not see any benefit in these sessions. In Section D we collect some thoughts on how to attempt to make the sessions more attractive. That said, there will probably always be a fraction of students who prefer to study/solve problems by themselves and not participate in these sessions. Making the exercises compulsory is not an option we are considering at the moment.

D) Suggestions for modifications and measures until next time the course is given (VT2021)

Based on the student feedback and our own considerations, we aim for the following modifications to the course.

On a general note, it seems that it would be a good idea to even more clearly state in the beginning of the course what the students can expect from it (and what will be expected of them). Some of the feedback appears to be a result of unmatched expectations between teachers and students, for example the level of the course being perceived too low by some students, the exam being perceived harder than expected, the exercise sessions being expected to be demonstrations of problem solving, the labs being inefficient… In some of these cases it might help to explain more clearly the motivation and goal for the different parts of the module.

The part of the course that needs most work are apparently the labs, especially in terms of organisation, but also their contents.

The M4 lab will be extended by integrating the 'add-on' of studying rolling cans into the lab and its manual, to make the whole lab more coherent. An alternate lab space has been identified.

One issue with M1 is, that it is mostly performing one measurement that takes a lot of time, with a setup that has been prepared by the lab supervisors/technicians. Since the equipment is delicate and expensive, the students do not really get to interact with it a lot, which to some extent defeats the purpose of the laboratory. We will need to spend some time thinking about how/if the lab can be modified or enhanced to make it more engaging, but we should also consider replacing it completely. This will have to be discussed with the teachers for the autumn term as well.

In either case, the completeness and quality of the lab manuals will be revisited.

The organisation of the labs has to be agreed on with the teachers of the EM course as well, but based on the feedback received for the mechanics course, we'd suggest the following:

- The split into two lab periods should be kept for now, but reports should only have to be written for two of the labs (one for mechanics and one for EM). The other labs will be graded based on lab books/quizzes during the lab.
- The deadline for handing in the reports should be extended somewhat, to maybe 4 days.
- There needs to be a clear grading scheme for all labs and the lab supervisors have to be consistent among each other in how they grade. This might require training/instructions to the lab supervisors to a greater extent than has been done so far.
- The coherence between the actual labs, the report writing workshop and the introduction lab should be increased.

For the exercises, the feedback indicates that we should promote more interactions between the tutors and students, and a more active engagement from the tutor side. However, we do not think that the exercises sessions should be reduced to the tutors presenting solutions to problems at the board. The explicit goal of the sessions is to get the students to work on problems themselves, alone or in groups, with assistance. Still, discussing the solutions (or other questions) in the whole group should also be part of these classes. We could also consider having the lecturers attend at least part of the exercise sessions more regularly, to be even more available and provide additional opportunity for questions/discussions. Offering problems/sessions at different levels of

complexity could also be a way of increasing the attractiveness of these sessions. We should also consider the timetabling suggestion.

Different levels of difficulty could also be incorporated in the hand-in problems, and we will try to improve the questions. We might want to reconsider the bonus to be gained. One option could be to not give bonus marks, but instead use one of the problems from the hand-ins in the exam. This would put an increased emphasis on understanding the solutions to the problems. We will discuss submission of answers via canvas.

On the lecture side, it appears it would make sense to spend a little less time on the very basics in the beginning of the course, and instead leave more time for some of the more advanced topics in the end. The demonstrations could be made even better use of by incorporating them more as elements of active learning, for example in combination with the appreciated clickers. We can also include more examples/problem solving in the lectures. In order to address the comments on too early starting times and too long lecture blocks, we could consider to shorten the breaks somewhat, for example having only one longer break in the middle and keep the others shorter, such that it would be sufficient to start at 9am without reducing the total lecture time too much. This could be combined with a shift to having the students be obliged to do some prep work before the lectures.