# TAM2030, Spring 2011, ABET assessment

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## 1   Documents provided

The total assessment consists of the 4-page assessment you are reading now, as well as various supporting material (the other items listed below). In total:

1. **This 3-page summary** report, *TAM2030, Spring 2011, ABET assessment*. This is the only narrative assessment.

2. **The course syllabet.** This briefly describes the course and its objectives.     `CouseSyllabet.pdf.`

3. **Exams.**  The prelims and exams given, with solutions.

4. **Course survey** The results of the course questionnaire.

5. **Course WWW site.** http://ruina.tam.cornell.edu/Courses/TAM2030-Spring2011/. This has the syllabus and all information about the course content, its structure and its grading.

## 2   Coverage of "Learning Outcomes" on exams

The columns in the table below are the 6 learning outcomes described in the course syllabet.

| | #/25 | 1. FBDs | 2. Paths | 3. Ang vel & acc. | 4. Eqs of motion | 5. Cons laws | 6. Harm. mot. |
|---|---|---|---|---|---|---|---|
| Prel 1, Q1 | 18 | X | X | X | X | X | |
| Prel 1, Q2 | 19 | X | X | X | X | | X |
| Prel 1, Q3 | 10 | | | | | | X |
| Prel 2, Q4 | 19 | X | X | X | X | | |
| Prel 2, Q5 | 21 | X | | X | X | | |
| Prel 2, Q6 | 20 | | X | | | | |
| Prel 3, Q7 | 16 | X | X | X | X | X | |
| Prel 3, Q8 | 19 | X | X | X | X | | |
| Prel 3, Q9 | 16 | | X | X | | | |
| Makeup, Q10 | | X | X | X | X | X | |
| Makeup, Q11 | | X | X | X | X | | X |
| Makeup, Q12 | | X | X | | X | | |
| Final, Q13 | 17 | X | | X | X | | |
| Final, Q14 | 17 | X | X | X | X | X | |
| Final, Q15 | 13 | X | X | X | X | | X |
| Final, Q16 | 18 | X | | | X | | X |
| Final, Q17 | 8 | X | X | X | X | | |

Table 1: Coverage of the 6 learning outcomes on the exams. Column 2 shows the average student scores, out of 25. No average was calculated for the makeup exam. Most students ran out of time on the final exam before getting to the last question.

# 3    Objectives and outcomes

As one can see from the table above, the exams were reasonably aligned with the course objectives. The outcomes are hard to measure. Why? Because it is a matter of choice how much we want to teach to the tests that we give. The tests were designed to distinguish students from each other, not to see how well the course outcomes were achieved.

On the whole, we feel that the students were engaged and improved with regard to the skills and concepts we were attempting to teach. But we cannot claim near universal competence at the things we were teaching.

# 4    Some issues appearing in student work:

1. Many students too-much want to use, in a freshman-physics-like-way simple conservation laws even when they don't apply.

2. More generally, they want scalar approaches to work even when vector approaches are demanded.

3. Even more generally, the weaker students tried to plug in any number of freshman physics formulas independent of their relevance to a given problem.

4. When solving problems with multiple degrees of freedom students were often not clear about how to get an independent set of equations.

5. Students had trouble understanding directions of forces due to springs and dashpots in problems with multiple masses.

6. Many students never learned Matlab well enough to read Matlab code and recognize dynamics concepts. For example they could not recognize equations of motion of simple systems written in Matlab code.

7. Many students never really mastered the kinematics of pulleys in complex problems.

8. Many students had trouble doing familiar things in unfamiliar contexts. So, for example, they forgot how to calculate the acceleration of the end of a simple pendulum when distracted by the pendulum having a second pendulum hanging from it.

# 5    The student course evaluations.

The end-of-the-semester course evaluations reveal the following main issues:

1. Although the text (Ruina/Pratap) was decently rated (3.5/5) several students thought it was too similar to the lecture.

2. Although labs were neutrally popular (3/5), there were far more negative comments about the lab than positive ones.

3. Although 75% of the students spend 8 hours or less per week working on the course outside of class. Several students thought the course should be 4 credits and that the homeworks are too long.

4. Although many students appreciated learning and using Matlab, others thought there was too much of it.

# 6 Innovations and their success.

As judged by students, the course went well this semester: instructor overall rated 4.18/5, course overall rated 4.00/5. This is in part due to various innovations (mostly not original) which are described below. Improvements in these are also suggested below.

1. **One point for survey.** We gave 1 point (/100) for completing the course survey. Thus we got 89% participation in the final course evaluation and can read those with reasonable confidence that they represent common opinion. No complaints about this from students.

2. **Drop the lowest.** Grading was based on an elaborate drop-the-lowest scheme. The homework grade allowed the dropping of the two lowest homeworks. And the overall course grade allowed good homeworks to substitute for one exam question. The exact formulas for this drop-the-lowest scheme are described on the course www site on the exams page. This scheme, in all it's complex detail, was regarded as a big stress-reliever for many students.

3. **'I worked 6 hours'.** Students were given full credit for a homework assignment if they wrote at the top "I wrote 7.5 hours on this." Or any other number of hours ≥ 6. Again, this was a big stress reliever and also motivated students who were struggling to at least try, they would get rewarded for trying.

   **Suggested change:** Students should only get 90% credit for their time. Full credit should be reserved for students who really got the problems.

4. **Solutions posted before homework was due.** Students liked this. And it cut down on crowds in office hours. I have mixed feelings about it. Certainly some students took too much advantage. On the other hand, it was a pressure relief also.

5. **Clickers.** Almost every class started with a multiple-choice clicker question. Then the statistics of the results were shown. Then the correct solution was discussed. Sometimes the questions were designed to highlight the student misunderstandings (w/ less than 20% getting the right answer). Sometimes they were designed to show the students that they had learned something. Students got 4 points for voting and 5 points for the right answers. One consequence is that, even though lectures were on tape, attendance was pretty high (about 100/136 students in most lectures). There were no complaints about the clickers.

6. **TA meetings.** This doesn't show directly in the course evaluations, but I think it did help make the course go well. *All graders and TAs met once per week and did, all of them, problems at the blackboard.* By this means their own strengths and weaknesses were shown to them. And by this means I, Andy the Professor, could show the course staff approaches that I hoped the TAs, and thus the students, would learn. A problem with many courses is that the whole staff is not really pulling together, and this really helped. It's the first time I've done it, and I think even the TAs and graders liked it.

7. **Problem Sessions.** Four times a semester, for two-hours each time, groups of 12 students met in Thurston 204 (blackboards on 3 of 4 walls) and worked in pairs solving problems with a TA. Of 88 comments on the course evaluations about these, 60 said they were worthwhile, some said *very* worthwhile. Only 16 of 136 students said they were not a useful use of time. Many students said they were too long or too tiring, however.

   **Suggested change:** Add at least a 5 minute break in the middle. Mix them up with, perhaps, simple string-and-mass type demonstration experiments.

8. **Lectures were videotaped.** There were no negative comments on this and a few positive comments. Through the semester, however, we got many positive comments on the usefulness of having video lectures. We have a system for this that takes about 30 minutes of staff time, beyond attending lectures, to get online.

9. **Redos for exams.** Students who got 19/25 or less on an exam question could redo it, graded out of 20. The recorded grade was then the average of the original and redone grade. This was regarded as a huge

pressure-relief for many students. Many students probably did this mindlessly. But many, we hope, were thus forced to think through their errors.

**Suggested change:** All but the first prelim should have on it a question nearly duplicating an earlier prelim question. Students should be warned that this is the case and that such problems would be graded extremely strictly.

10. **Extra time on prelims.** All prelims were written so that a good student could complete them well in under 90 minutes. All students were given up to 3 hours to do all prelims. There were no complaints about this. This was a big pressure relief.

11. **A single makeup prelim.** At the end of the semester there was a single makeup exam for all those who could not take one of the prelims. One 90-minute exam (for which they had 3 hours to work), kind of a mini-final for all such students. Any and all excuses were accepted for missing earlier exams. There was no threat or intent that the makeup would be harder than other exams. This was mostly a pressure relief for the staff.

# 7   Eliminate the lab?

From both my point of view and that of the students, the problem sessions were of much higher value than the labs. Without being asked, many volunteered exactly that opinion. My suggestion would be

1. **Eliminate the present labs**

2. **Eight problem sessions.** Have each student attend 8 problem sessions in the semester. Each would be 2 hours (with breaks) and each would have 12 students maximum.

3. **Labs light.** In these sessions include simple table-top quick-to-assemble mass-string type labs with associated calculations.