Course Analysis
EI1120 Elkretsanalys för Energi och Miljö (CENMI program) 7.5p
VT17 P3 (2017-01-17 – 2017-03-16)
Nathaniel Taylor

Staffing
Responsible department: Electromagnetic Engineering (KTH/EES/ETK)
Course-responsible, Lecturer, Examiner: Nathaniel Taylor (writing this analysis)
Examiner: Daniel Månsson
Other teachers (övning): Kun Zhao, Per Westerlund

Events
Lectures: 14 double-period sessions (i.e. 21h), usually two per week.
Tutorial (övning): 14 double-period sessions (21h), usually 1 day after lecture, free choice of two parallel groups.
Laboratory tasks: 3 obligatory lab sessions, each taking 1 to 2 hours; an optional 4th task was offered near the end.
Homeworks: 12 homeworks, submitted by email or paper; passing 6 is obligatory, doing more gave exam bonus.
Lectures and tutorials were generally well attended: definitely the majority of the class (70–80% at a guess).
The first six homeworks were passed by around 60 to 70 students; later ones were passed by around 30 to 50.

Registered students
As of 2017-01-18, 70 students were in the "Anmälningslista" (KTH-Social); 61 were marked as being registered
64 took the main exam in March, and 17 took the re-exam in June
77 participated at some point during the course (KS1, KS2, exams, homework, lab).
In summary, this is quite similar to last year, but with marginally (<10%) fewer students.

Results
The same principle was used as last year: a final exam and two part-exams (KS) that can contribute to it.
Questions were in a similar style to last year, in spite of temptations to be more varied and adventurous.
Exam, 2017-03-16: 64 students, 80% pass: A (6), B (9), C (12), D (15), E (9), Fx→E (1), F (12)
Compare to earlier years (pass rates are after any Fx completions):
2016: 69 students, 90% pass: A (2), B (18), C (14), D (10), E (8), Fx→E (10), F (7)
2015: 81 students, 88% pass: A (7), B (21), C (19), D (20), E (4), F (10)
I have no simple explanation for the ~10% difference in pass rate compared to previous years.
Re-exam, 2016-06-08: 17 students, 47% pass: B (1), C (2), E (1), Fx→E (4), F (9)
Most students were newly registered to the course this year, and either passed all or failed all of PRO1/PRO2/TEN1; thus the proportion of available points (hp) obtained during this round is similar to the pass-rate of the exam.

Course "moments" and points
The course's 7.5 points are distributed between the final exam (TEN1, 5p) and two "projects" (PRO1/2, 1.0 & 1.5 p).
Passing the PRO moments requires lab attendance and the minimum number (6) of homeworks being approved.
The final course grade (A-F) is the same as the exam grade, when all moments are approved.

Prerequisites
The impression is similar to last year. Maths seems adequate, as the main cause of lost points in the exam was errors in circuit-analysis concepts, not in handling equations. There was clearly some time taken for learning / remembering / deepening about complex numbers, ODEs and particular algebraic steps that arise often in this subject; but that is only to be expected.

Course material
See VT16 course analysis for a more detailed overview of the course material. All core material is available on the webpage: it includes notes, exercises, homeworks, past exams, solutions and lab descriptions.
The main change in VT17 was in the course "notes" – see next paragraph.

Changes that were made in this VT17 Course-round

Changes were mainly small.

Two of the intended changes from the VT16 course analysis were followed: more concise notes (lecture material), and “central control” (by the course-responsible) of the choice of tutorial questions. The previous computer-typeset notes (lecture material) were relegated to the role of an alternative version for students who are happy with text-intensive documents, while shorter hand-written notes took over as the primary material. This seems to have been positively received, without any complaints about having the choice. There is plenty of room for improvement: the later topics in particular had their material produced quite hurriedly.

Two considered changes from VT16 course analysis were not followed: no labs were removed, and serious quizzes (where each student would be pushed to respond, e.g. with clickers) were not included in lectures. Reduction of the number of labs is now planned for VT18. During VT17 we have had a few questions in each lecture where students can work on a step themselves. This seems useful as a wake-up and a stimulus to pay attention. Feedback and observation suggest that with the short available time it could have negative effect to try to get answers from everyone on non-trivial questions, which would take at least ten minutes each, and would not suit those students who don't focus well when pushed by a close deadline. We have exercises available for self-study immediately after each lecture.

The “three phase” topic, at the end of the course, is a known problem: in VT16 it was given two lectures and two corresponding tutorials, but was still seen as one topic. Now in VT17 “three phase” was split into balanced and unbalanced situations, as separate topics with their own notes and exercises. There's no particular sign that this made things better, or worse, but it seems desirable to keep the clear split into more manageable parts. Further work is needed on this part of the course, which again appears to have been perceived as unclear by many of the students who got through the rest of the course with less trouble.

Evaluation

A mid-term evaluation was done by distributing paper in a lecture (2017-02-06, 36 responses) for any comments to guide us about timing and other issues. Example issues were suggested, that would be relevant to take up; but anything could be commented on. In general the structure was liked and the timing and load was not seen as a problem at that point. Basic points about lectures and tutorials were “write bigger”, “speak loudly, use microphone when available”; these aren't for the first time, so we really should try harder with this from the start next time. Suggestions from just a few people included writing lab tasks in Swedish to speed up their reading. A few pointed out that the new hand-written notes had some unclear parts, e.g. careless writing or too much clutter: I agree, but have found how even this quick method of writing takes surprising time.

A final evaluation was taken far too late (2017-11-23, 7 responses). Earlier we've done a paper-based evaluation in a lecture, getting around 50% response-rate; experience from KTH-LEQ in other courses has been only around 25%. This time the idea was to summarize intentions for the next round, and to make a few simple questions on a web form to solicit comments about this round and the intentions; but time-press kept postponing this. Finally, a simple response-form and draft course-analysis was sent to all participants in November, receiving several helpful and analytical responses besides one very reasonable response of “too long ago to remember”. The following were the main points. Course-load was seen as heavy but not unmanageable. Lectures have apparantly improved since earlier years, which was hoped for after significant effort put into the structure this time. Tutorials received more criticism than usual, being seen as too much into small details (one group) or not very structured (other group): in VT18 tutorials will have a different teacher anyway, and just one group. Mandatory preparation for labs was suggested by two responses, with the purpose of improving learning at the lab. This was considered in EI1110 (Elektro) course-analysis a few years ago, but was worked around fairly well by pleading with students to come prepared, making clear the reason. We must consider this question further: labs are fitted tightly in time, after introduction of the respective topic, so any pre-lab assessment that can stop unprepared students coming to the lab would need quick feedback; combining lab preparation with a homework could perhaps acheive the aim.

Summary (my overall impression from the course and the evaluation responses)

As in several previous years, the overall impression is very positive, both about the student group and the way that the course fits them. There has been good, focused work: circuit skills and general skills have grown strongly. Uncomfortable workload has only been hinted at in a few cases, and is a combination of two intensive courses. Particular features of the course design considered important for the positive impression are: regular homeworks, the style of the homeworks, division of work between two KS and the main exam, and a very clear structure for what technical content comes into each part of the course. This overall structure appears to work well with this program.

The main bad-spot is the final part of the course, about three-phase solutions (mentioned above under the “Changes” heading). This subject has over the years been perceived as hard and confusing: several “improvements”

have been made in the timing and course material, without managing to remove this perception. Should we keep these topics in the course at all? I think we should: three-phase systems are fundamental in electric power, and should not be alien to graduates of Energy and Environment – not even those who haven't taken the electrical direction of MSc studies. My belief is still that this is “not fundamentally hard”; but some other approach is needed. The combination of new terminology and of quite heavy symbolic phasor-calculations is plausibly a large part of why the core principles get hidden. Making the calculations be trivial (done numerically by computer) and the terminology be familiarized through group-work, is hoped to improve the situation: see the planned changes for VT18.

For further comments about possible major changes (e.g. more applications, projects, simulations etc) and reasons for not having done these, see the 2015 course analysis.

Changes for the next (VT18) round

The main intended changes for 2018 are:

- Laboratory: reduce to just two labs (remove opamp lab, as planned last year). This avoids the lab that was seen as the least clear, and makes the scheduling less constrained around the time of KS2. CENMI program has not appeared to find the labs so stimulating or useful as CELTE (Elektro); this is based on our perception in the lab, and by evaluation feedback in previous years.

- Introduce computer-based projects near the end of the course, possibly in place of the pen-and-paper homeworks. This is hoped to enable students to focus on the fundamental concepts of three-phase calculations, rather than getting stuck in the details of symbolic manipulation of phasors. Tasks based on Matlab/Octave code should be introduced a bit earlier, e.g. as parts of homeworks at the start of the AC section of the course, so that students are already familiar with handling complex numbers by computer as well as by hand. Then the final few tasks can be almost entirely calculated in this way. Encouraging phasor diagrams in the working and solutions may also help. The exam is traditionally symbolic, 'by hand': alternatives that focus more on the physics than the maths, are symbolic solutions written without simplification, or numeric solutions done by calculator, or just dropping three-phase calculations from the exams and instead doing such calculations by computer in project tasks near the end of the course.

- Tutorials: instead of two parallel groups (two “teaching-assistants”, with students choosing which to go to) there will be just one group, in a large room available in KTH's new U-building. This is partly by necessity, as we can't find a second assistant, but it's also because for several years there has become a de facto single group, i.e. almost all students have chosen one group due to different styles of the assistants. The tutorial teacher will be new to the course this year; he will attend lectures to be sure of the topics and notation that students have seen. Comments from previous years' evaluations about clarity, speed, etc will be discussed beforehand.

- Lab preparation: provide clear preparation task, to permit more efficient use of the time in the lab. It's not yet decided how to do this: homework with deadline before lab, or web-based test that must be passed before the lab, etc. Time-constraints of the schedule and the teachers will determine what is done.

- It would be good to improve the hand-written notes, particularly for the last part of the course .. with limited available time, it's likely this will only happen for a subset of the notes that appear most in need of improvement.

Further things to bear in mind before and during VT18 are time-coordination with the parallel course and possible ski-trip (!), particularly around the time of the KS. See e.g. comments in the mellanutvärdering VT17. The schedule looks good, and avoids clashes between course events and förlängd skrivtid at KSs. Homeworks need to give attention to other course-load.