Course Analysis

EI1120 Elkretsanalys för Energi och Miljö (CENMI program) 7.5p

VT15 P3 (start 2015-01-20, exam 2015-03-17)

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Staffing

Responsible department: Electromagnetic Engineering (KTH/EES/ETK)
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Events

Lectures: 14 double-period sessions, i.e. 21h, two per week.
Tutorial (övning): 14 double-period sessions, i.e. 21h (two parallel groups, free choice of which to join).
Laboratory tasks: 2 opportunities offered; the task takes from 2 to 4 hours.
Homeworks: 12 homeworks, submitted by email (no timetabled hours are associated with these).

Lectures and tutorials were generally well attended, i.e. the strong majority of the class (80% at a guess).
Almost all new students (~90%) kept up to date with the homeworks.

Registered students

As of 2015-01-30, there were 63 in the "Anmälningslista" (KTH-Social).
81 took the final exam in March (ordinarietenta).
93 were seen at some point during the course (KS1, KS2, or final exam).

Results

Exam (ordinarietenta VT15) 2015-03-17: out of 81 students, 70 pass-grades: A (7), B (21), C (19), D (20), E (3).
Compare to the 2014 round, with 78 taking the exam: A (22), B (26), C (11), D (11), E (3), 5 (F) [after Fx-completion].
The pass-rate on this main exam was thus 86%. It became 89% after Fx-completion.
Re-exam: (omtenta VT15) will be 2015-06-11. There are 28 registered to it.

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).
This year, for the first time, newly registered students did not automatically pass the PRO by passing the exam: instead they had to complete 10 of the 12 homeworks for PRO1, and to attend all 3 laboratory sessions for PRO2. Students repeating from earlier years were allowed to pass PRO by passing the exam, although they were welcomed to do the other activities too and to get bonus points from the homeworks.
Most students either passed all or failed all of PRO1/PRO2/TEN1; the biggest exception to this is that 7 students passed PRO2 (lab) without passing the other parts.

Course material

This year there was no other book or external resource that was suggested as the course-literature. A few external textbooks were mentioned as options for anyone who might find our own material insufficient. For each Topic (lecture subject) PDF files of Notes, Exercises, and Homework were put on the website, with homework solutions following after the deadline. For each lab exercise the task description was provided on paper in the lab, and was available as PDF on the website beforehand; then a detailed summary was put on the website after the lab, for students to check their calculations against. Many past exams and solutions are also available on the course website.
These online resources constitute the course material. No suggestion was received that this core literature needed any supplement. No interest has been shown in having paper copies available.
The old KTH compendium (G. Petersson) is available from STEX and is recommended as a supplement for learning the Swedish terminology, doing further practice questions, and possibly as an alternative source for students who prefer its style (tastes in literature are very varied).

Course Aims

See the official course-plan, catalogue etc for formal aims. The main aim that I emphasize in exercises and examination is that students should be able to solve circuit diagrams , to find typically voltages, currents or powers, for discrete linear circuits,in dc, transient and ac conditions. This main skill can be built upon in later courses that more directly apply circuit analysis to technical situations, particularly in electric power contexts.

There are several more general skills that are also cultivated in the course:

- Familiarity with computer-based methods is encouraged by the homeworks, which often use examples with short Matlab code. Computers are also encouraged for solving or checking equations.
- Dimensional analysis is refreshed and is strongly encouraged as a habit for checking.
- Checking reasonableness of results, and alternative more intuitive ways of seeing a result, are trained in several parts of lectures, exercises and homeworks.
- There is a lot of practice of handling algebra, and of choosing a suitable approach to each problem.

Summary (overall impression)

The students' motivation and ability was similar to last round: high and impressive, with good self- and group work outside scheduled hours. Only a few fell behind. Ten or so from earlier rounds completed the course successfully this time. The students' comments again indicate that several features of the new course design were important for achieving this pass rate, which is high for any of our circuits courses. In particular: 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 very well with this program (most of the changes from the older circuit-course design have been first tried with this program).

Changes that were made in this VT15 Course-round

See the Course Analysis from the VT14 round for more details of the rationale for the changes that were planned after that round and implemented now. There has not been much change to the subject content or the examination structure, but significant changes have been made to the literature and the laboratory work.

- Laboratory tasks were the main novelty for VT15. Three were included, each taking about 2h. The lab room with 11 double places at Osquldasväg 10 was borrowed for these occasions. In contrast to the plan, the first lab task was not fitted in early enough to help with really basic concepts (such as “what is a node”) at the time when that help is needed. This was partly due to late scheduling and room-booking of the labs, and will be improved by including labs in the scheduling system. The style of having no obligatory preparation or report-writing around the lab was appreciated, for the exact reasons it was chosen – freedom to try to learn from the lab task without other stresses and motives, and avoidance of excessive work-load.
- Frequent homeworks were tried for the first time back in VT14: the evidence for their usefulness was strong, so they were kept in this round as the formal way for new students to pass PRO1. Based on consideration of the time-demand, the homeworks were cut down to a single, smaller question for each Topic, and other parts were moved out into the Exercises collection.
- The external textbook used as main course literature in previous rounds was not used for this round. The provided course material replaced it, supplemented by the old KTH compendium. A few textbooks were suggested, but only as options. All the feedback suggests that the new choice is not only acceptable but also is preferred. This is understandable considering that the sequence and coverage did not align fully to the course, and that circuits textbooks tend not to be power-oriented.
- A set of “Exercises” was started in this round, designed to allow each new Topic to be practised, from quick simple confidence-boosting practices through to exam-level questions. This is the least mature of the course material, and will be grown considerably before next time. Its importance became apparent in EI1110 HT14 (Elektro), where no textbook was required, resulting in some students requesting more exercises.

Examination

The same structure was used as in the previous round, with points split between DC (Section A, 12p), Transients (B, 10p) and AC (C, 18p). Sections A and B could be replaced by KS1 and KS2 scores, respectively, if these were better. Up to 2p (5%) could be added to the total by bonus points from on-time homeworks. The level was considered a bit harder than last year, due to a few small final parts of questions that were tricky or required particularly “conceptual” thinking in order to find a manageable solution method. This level is intended to be maintained next year: see more discussion about the course-evalation comments (appended). No further significant change is planned.

Teaching (approach, perceived results)

The structure and the activities without teachers present (such as exercises and homeworks) have already been discussed, and are working well. In the following, only the contact time in lectures, tutorials and labs is considered.

Labs were served adequately by 2 or 3 teachers. For next time we would do well to consider how little we can (or should) describe details of what to do, in order to get the best learning in the available time: this time it felt sometimes as if too much help was given. No particular comments were recieved about the teacher aspects of labs.

Tutorials were clearly very much appreciated, with both parallel groups doing a mixture of own work towards a solution and then discussion through to the correct solution, according to the tastes of their teachers. The style was well commented on, and no negative comments were received.

Changes considered for the VT16 round

The following intended changes are relatively small details compared with previous changes. Their rationale can be seen from other parts in this analysis, including the comments about the quotations from the course evaluation.

- Literature: add many new exercises; refine the notes and vary the homeworks.
- Laboratory: schedule carefully to get labs at good times; revise the instructions.
- Lectures: plan in more detail, including careful choice and timing of quiz / "peer instruction" questions.
- Tutorials: no change planned: but one teacher will be new to the course.
- Exam/KS: consider some variation in style, e.g. perhaps some multiple-choice parts.

Prerequisites

The main cause of lost points in the exam was errors in circuit-analysis concepts, not errors in handling equations. I therefore would say that mathematics was not a serious problem. The part found hardest with the maths was complex numbers, where the required level of familiarity in the AC part of the course was clearly beyond most students' initial competence: the competence was quickly gained, but this process takes time that would ideally be spent on the circuit analysis. As far as I'm aware, complex numbers are not intended to be a big part in the previous education, and have been remembered from school instead of being recently studied at KTH, so it is not strange that our heavy use of these requires some practice. Differential equations had been largely forgotten, but came back quickly; I know the feeling.

As with previous rounds and programs, there appeared to be little practical concept of electrical basics, such as field quantities, potential, voltage, etc., e.g. how these are related to physical circuits.

Other

This time, there was a link-meeting and experience-based scheduling for EI1120 and KE1060: the problems of last time (e.g. extended KS-times running into other lectures) were avoided.

Guest lectures (2) were scheduled into extra 1h slots within or after normal 2-period lectures, instead of being fitted within an existing lecture slot. This had the rather suprisingly strong effect that the great majority of students (e.g. 80%?) disappeared when they realised the guest lecture was not part of the examinable material; although the stress of other courses is understood, it was a bit surprising that so few were interested in these more general energy-related views of electric power.

Most of this document has considered changes only within the existing components of the course, in its current structure. It is sensible to take also a more open-minded view of the course, bearing in mind that nothing about its present structure or components (e.g. lecture, homework, lab) strictly has to be continued. All kinds of ideas can come to mind, towards the goal of "intuitive understading of circuits", ability to design circuits for some [simple] real applications, etc. We could be more project-based, with more design-oriented tasks and group work. Projects could be designed to connect to laboratory sessions as well as the lectures and homework tasks. Assessment of projects and/or homeworks could be done by public presentations with peer feedback. (These preceding points are the most directly tempting to me at the moment; the following ones are rather less tempting.) The lecture periods could be made more interactive and more dependent on prior study of the topic, or could be replaced entirely by printed/video resources, and the time used for more discussion of work that the students are doing with projects or homework tasks.

However... For the CENMI program, the existing structure is clearly liked. Students turn out remarkably able at solving quite varied exam questions. Almost all appear to pass the course without undue stress. Every part in the course has been modified or newly introduced in recent rounds and their analyses. No major change feels pressing, after this VT15 round and evaluation. Any major change would be disruptive, with the risk of not working as well as now. A change to the level or style of the examination would be bad for morale when comparing to previous students' grades and past exam solutions (cf. the complaints about the slightly harder AC questions this year). Changes would also cost a lot in our time as teachers. Therefore, no major change is intended. The incremental changes to existing activities will be implemented before next round, partly within the course for Elektro in the autumn. Bigger changes will be considered after that, and in the light of expected experiences in the Elektro (EE) circuits course, where differences in the program, timing and student group make it more tempting to experiment with projects and group work.

[end of main 'analysis']