

Course Analysis

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

VT22 P3 (2022-01-18 – 2022-03-17)

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Staffing

Responsible department: Electromagnetic Engineering (KTH/EECS/EME)

Course-responsible, Lecturer, Examiner: Nathaniel Taylor (writing this analysis)

Other teachers (övning, medrättande): Md Zakaria Habib (second half of course), Md Tanbhir Hoq (a few tutorials)

Registered students

85 students participated at some point during the course.

This is typical of past years, other than the exceptional >100 in 2019.

72 were registered for the first time on this course.

Events

Lectures: 15 double-period sessions (i.e. 22.5h), usually two per week.

Tutorial (övning): 14 double-period sessions (21h), usually 1 day after the corresponding lecture.

'Laboratory' tasks: 2 (obligatory), the first by submitting a report on a computer simulation, the second in the lab.

Homeworks: 14 quiz-based tasks; require #1 approved, #2-#13 with $\geq 80\%$, and #14 with $\geq 90\%$.

Lectures and tutorials were initially online only; by the middle of the course they were on-campus but also on video, and were attended 'live' by rather under half of the class, which is less than in pre-covid years and may be due to intentions to watch videos later.

Guests: Guest lectures from Svenska kraftnät and LKAB (mining) were given by remote guests in zoom, to a mainly in-lecture audience. An on-campus lecture was given by a KTH guest, about energy systems. Each of these three guests gave a perspective about a part of the energy transition in Sweden (or further), and what it is affecting for different companies, particularly about electric power engineering.

Course 'moments' and points

The course's 7.5 points consist of the final exam (TEN1, 5.0p) and two other 'moments' (PRO1, 1.5p; PRO2 1.0 p).

Part-exams (KS) are an alternative to sections of the final exam, whereby the better of the KS or exam section is used.

PRO1 is passed by a required mean score on homework quizzes, and PRO2 is passed by passing both labs.

The final course grade (A-F) is the same as the exam grade, when all three moments are approved.

Results

The same principle was used as since 2014: a final exam and two partway exams (KS) that can contribute to it.

However, note that both KSs, and the exam and re-exam, all used invigilated Canvas quizzes as their format this year.

Exam, 2022-03-17: 64 students, 84% pass after Fx completion: A (12), B (5), C (11), D (6), E (20), F (10)

Re-exam, 2022-06-08: 12 students: A (0), B (0), C (2), D(3), E (5), F(2)

This is a similar distribution to earlier years other than 2021. It is an improvement over 2021. Given that we had reason to suppose that the course environment was better this year (more in-place meetings, less restriction generally for students meeting on campus, and better management of what online events there were at the course-start) we make the vague inference that the different format of the exam this year has not changed the results significantly; i.e. the change since last year is thought to be more about study environment than examination level.

After the re-exam, 81% of new-registered (this year) students had passed.

Prerequisites

Adequate. Similar points to earlier 5+ years: our prerequisites are really only in maths and fundamentals of units, etc.; no electrical background is needed. Problem-cases are more about points in the course's own content, than about lack of the maths.

Course material

The main material for subject introductions was as in several previous years: "notes", "chapters", "exercises", and past exams/solutions. All this material was available online on the course webpage from before the start of the course.

A change this year was the use of Canvas quizzes, for homework tasks and also for both KS and exams; the tasks can be seen as another part of the course material. Most of these were more summative than formative in purpose and style, and without the thorough worked solutions of the material such as the exercises and past exams. However, the quiz for the final project-task (longer task), which is based on a practical application of the course's subject, was designed to introduce ideas along the way.

Special situation - continued covid restrictions

[History: The 2020 course-round was business-as-usual, before covid restrictions started. The 2021 course-round was held under covid restrictions, with zoom-based meetings, pseudo-labs (simulation tasks), and zoom-invigilated home-exams; only the part-exams (KS) were on site.]

For 2022 it was expected and hoped that the course could run in a normal or almost normal way. At about the last minute, this was changed, because of sudden tightening of restrictions for some weeks starting in mid-January 2022!

Lectures and tutorials in the first weeks were therefore online (zoom), but from halfway through the course some of these were in rooms and also videoed in zoom for live and archived access. Our equipment was changed from last year: for example, a stylus pad, instead of a webcam and paper, was used in zoom.

Lab1 was again simulation-based, but Lab2 was done in the labs as usual.

Both KSs and the exam and re-exam were invigilated in computer rooms.

The sudden change of plan at the start of this course-round was a pity, but overall the course went better than in 2021, from the course-responsible's perception (including consideration of student feedback).

Evaluation, with discussion

An anonymous free-from question (webpage with text-box) was made available after the KS1 and then after the main exam, to get comments. It was not pushed hard and there were under ten, short, responses in total. More significant feedback actually came in lectures and emails, with comments and questions mainly about the assessment.

Due to this feedback and discussion we downgraded the initial requirement for homeworks (from 100% on 100%, to 80% on 9 of 13!), recognising that the purpose is mainly to check oneself and it could cause time-waste to keep retaking honestly for an elusive last point. We also, after part-exam KS1, modified the exam principle so that the best of two submission attempts would be used instead of just one submission, in order to self-catch small errors, misunderstandings about the Canvas presentation of numbers, etc. After this, there was no comment on too-stressful deadline effects of home tasks for this year. Students were pleased to have the immediate feedback instead of waiting for manual handling of twice-weekly tasks. The reason we ever introduced a requirement to do homeworks was to encourage regular work and feedback. The required level for passing is therefore not important for the course's assessment quality, as the final grade depends on the invigilated exam and KSs; but it should stimulate work, and require an input worthy of the credits (ECTS) given in PRO1.

There was surprisingly little comment about the quiz format of exams - just a few fairly neutral-to-positive comments, without complaint. This may be partly because a similar format has been seen in other courses. It doubtless helped that our homeworks used a similar format to the exam, so that there would not be any surprise or learning curve at the exams.

This year's course worked better than 2021, I'm confident to say. I speculate that this is mainly because the suddenly-imposed covid-restrictions at the start were expected to be short-lived (light at the end of the tunnel) and we got some real meetings and lab afterwards. A better preparation for online lectures/tutorials was also beneficial for making a clearer and more colourful visual experience, e.g. with stylus instead of videoed paper. Perhaps the more interactive

quizzes, rather than static homework tasks to hand in as scans, also helped make it more tempting to follow the course despite being at home during the first weeks.

In pre-covid years it was typical to see some positive comments about the benefit of lectures and tutorials for putting across the key points, inspiring people to start on a topic, etc. (besides usually a few little comments about making clearer headings, or larger text in some cases). This year there was nothing such in the evaluation, positive or negative. This might be chance, or low response rate, or because there was plenty else that we wanted comments on - such as the exams. But it would also make sense with the rather rushed nature of the course from the teaching side, due to the changes, development and parallel courses, which gave less time for preparation.

There was a lot of new work from the staffing side, as I had to spend a substantial time making 14 quizzes, 2 KS and 2 exams, while trying to fit our needs into a rather poorly suited system (Canvas New Quizzes) that has been gradually overcoming some limitations about where maths-symbols can be used, etc. This should pay for itself next year, with just minor adjustments to quizzes, as long as it works to copy them for a new course.

Significant Changes, with discussion

The use of quizzes in Canvas for homeworks and exams was new this year.

The KSs and exams were run as Canvas quizzes in a locked-down computer environment ('SEB' - secure exam browser), by students sitting in invigilated computer rooms. The security should therefore be fairly similar to the course's previous written exams, provided that computers are sufficiently separated or screened.

From experience in the KSs we iterated to having two submission attempts, with the higher score being kept; this removed problems when students were unsure of how Canvas would interpret a number, or when a small and easily caught mistake was made. Within a day of the test being taken, grades could be given.

Homeworks familiarized students with the same quiz environment, and gave immediate feedback. They allowed any number of submissions, keeping the highest score.

No significant problem occurred with the exams, such as technical failures. An IT technician was called to one exam for a case where one student had trouble logging in, but we didn't find whether this was actually a problem with the KTH or Canvas systems.

Our perception was overall extremely good for this as an approach, in terms of assessment, speed and work. Canvas New Quizzes was *not* a good experience for making, from the teacher side: it moves things around the page when one tries to edit, mixing scrollbars, doesn't support math-writing in various text fields where one wants it, doesn't have a numeric answer type for "fill the blanks" questions (which are the preferred sort for having multiple answers in a single question), formats text horribly, etc. It has admittedly slightly improved even during the duration of the course, and it is good at saving to avoid loss of work.

However, from the more-important student side, the Canvas New Quizzes worked well, the main annoyance being delays (spinning, waiting), and the formatting of text in some sorts of questions. So it's worth it that we spend effort making the quizzes, in order for many students to have the relatively good user-experience from their side.

An expectation at the start was that students in the exam rooms would be able to access a calculation program such as Octave or Matlab, while taking the quiz-based exam on the locked-down computer. This is a feature available in the 'SEB' program, but KTH has not sorted out a system for enabling the feature in a convenient way at the request of each course. It's suggested as a possibility for next year. This is a significant lack, as much of the initial motivation for this exam format was that the use of computers for handling calculations with complex numbers would allow the tasks to be more realistic of working-life calculations, and would allow us to raise the level of the given tasks by reducing the time needed for algebra or arithmetic. However, the other benefits of quizzes in computer rooms made this exam format worthwhile even without access to calculation programs, although it is *highly desirable* to improve this situation.

The main reasons for not moving to computer-room exams in the past were that: (1) we weren't aware of the number of available computer rooms and the locked-down environment until discussion in the teacher-team (lärarlag) in which another teacher had started using the computer rooms; (2) there was some worry about technical problems when needing 80+ computers and Canvas sessions to work well; (3) if all answers need manual checking then some of the advantage of computer-based exams is lost, but if most answer are automatically checked then this limits how well we can recognise 'wrong but almost entirely right in principle' versus 'clearly wrong in every concept', or indeed 'right, well reasoned' from 'right, only by two wrongs'. Points (1) and (2) are now taken care of. Point (3) has been dealt with by making most quiz grading automatic, but splitting the quizzes into more independent answers than was usual in the written exams, besides having two submission attempts in the KSs and exams so that incorrect answers are highlighted

and can be checked. In this way, a small error doesn't lose a whole grade-boundary or two, but it would be astounding to get most answers correct by luck, double-wrongs, etc. If the assessment should reflect what is needed in working life rather than just the shown conceptual understanding, then it's arguably better to require that most solutions be *right*, than to approve an exam where nothing is right but much is nearly right, as could happen on a manually graded exam when little errors with e.g. arithmetic are treated lightly.

Another change made in this round was the introduction of a brief task to be completed shortly after the introductory lecture. This was a specific sustainable development (SD) task. The course's subject clearly couples to electric power systems, given that this is a circuits course mainly for the Energy and Environment program. The introduction and guest lectures have always tried to show some of the ongoing changes with 'green energy'. However, this has previously been just by providing background information that is hoped to show that electric power is a worthy direction for energy-and-environment-interested students to choose for their later MSc program. There has not previously been a required task about SD. The task was simply to answer a few questions such as "which UN SD-goal do you consider most (positively/negatively) affected by electric power engineering in the (past /future)" and to identify one goal as least connected to electric power engineering. Answers were the number of the goal, and a few-sentence explanation. The results were compiled to show students what the whole class had decided, which of course was quite varied. The discussion around this was intended to show that surprisingly many such goals have clear connections to electric power engineering, and that easily available electricity can have many social consequences. The difficulty of judging whether the overall historic effect has been bad or good is a classic example of how complicated such a question really is, even if restricted to just CO₂ generation. This was not a carefully graded assignment, but it seemed to serve its purpose of making many students think further the subject's relevance to SD.

Treatment of proposals from the 2021 analysis

The plan to use Canvas quizzes for the regular homeworks, and ('possibly!') the exams, has been implemented fully, as described above.

There was not a significant change to other course material, e.g. with pre-prepared videos that were suggested in 2021. However, videos of our current year's online and on-campus lectures were made available so that students could see them later, repeat parts, etc. The course content was kept as in several previous years, despite some earlier thoughts about reducing certain topics to make more room for others.

For the next (VT2023) round

We have strong expectation that there will be no such restrictions in 2023. In that case, lectures and labs are planned to run as normal (2020 and earlier), in-place. There's a temptation to continue offering videos, but there's a counter-view that this encourages delay and sloth(!) and that it's good to encourage 'get up and get in'; we'll see how that debate/study continues.

Due to anticipated staffing issues, we may reduce the number of tutorials (övningar), or make a few more lectures and then interleave more example solutions in the lectures. This could change depending on the situation with suitable and available PhD students to help in the course.

The new system with Canvas quizzes that started in this 2022 round is something I definitely want to continue and develop in 2023. I have overcome the main worry about assessment quality in the context of the exams; and with short staffing it's essential to have automation of the main part of homework marking, if we're to give quick feedback. Some parts of the final project (longer homework) and possibly of the exam can continue to be manually checked, to allow longer answers and program code and - we hope - "more inspiring" feedback.

Again - as a few years ago - I feel that we would ideally have an overhaul of the exact content (perhaps remove/reduce opamps and/or some frequency response, and put in 2nd-order transient solutions and more ac power), and rewrite most or all of the scanned hand-written notes by using the stylus-pad and computer-written text. However, with my need to develop a parallel course from the ground up in the same periods, and the expected lack of assistants with either course, this is not likely to be feasible in the coming year.