Course Analysis

EI2439 Power System Protection 6p

HT14 P1 (Sep/Oct 2014)

Organization

Responsible department: Electromagnetic Engineering (EES/ETK)
Course leader, *Lecturer*, *Examiner:* Nathaniel Taylor (writing this analysis)
Examiner: Hans Edin

Course "moments" and points

The course's 6 points are distributed between the written exam (TEN1, 3p, A-F grade) and projects (PRO1, 3p, P/F).

Numbers and results

15 students took the exam; a few others came to one or two meetings but did not continue.
All 15 passed the exam during this round: no re-exam was needed.
However, 3 of these never fully completed the projects, so they did not pass the course: these appear to have been exchange students, needing to complete a certain number of points without necessarily finishing all the courses.
Exam results from ordinarietenta HT14, 2014-10-31, for the 12 students who passed the whole course:

A (2) B (3) C (2) D (3) E (2)

These results were also the "whole course" grades, after approval of the projects (PRO1).
The 3 students who passed the exam without the projects got exam grades of B, D and E.

Events

Meetings: 8 double-period sessions, i.e. ~16h, including presentation of projects
Guest lectures: 3h + 1h + 2h (A. Bonetti [FMTP], J. Wang [ABB], M. Saha [ABB])
Comments: The majority of the class was present at meetings, with obvious reasons (other courses) for any absence.

Course material

A webpage was used to describe each week's topics and schedule to course participants, including links to course literature, and project exercises and solutions. The literature was a wide range of different sources. It included links to book chapters available through the KTH library. The two most-used books were

Power System Protection, P. Anderson, Wiley-IEEE 1998, and
Protection of Electricity Distribution Networks, Juan M. Gers and Edward J. Holmes, IET Press 2011,

from which particular chapters or sections of these were selected for a particular week's topic.
The literature also contained links to several other books and papers, and to various product brochures and corporate-produced videos about protection schemes.

Structure

A lot of thought was put into the course content during the months when the new course was registered. This subject can be split in many ways, and different aspects included/omitted/emphasised. There are not many universities in Europe that have a dedicated course in this subject. Some of their course-websites were studied for comparison, after initial thoughts about how to set up the course. Unsurprisingly, this did not give much information about the level and style with which the various subjects were taught.

I decided to be a little unconventional, by starting from protection in low-voltage (LV) systems. This is not conventionally within the subject of "protective relaying". It is usually covered by different parts of manufacturing companies and by different groups of design engineers. However, it is significant in the work of many power engineers, and it was hoped to give a good starting point from which to move to higher levels of the power system where different demands of cost, selectivity, etc, imply different choices. The result was (to my mind) nicely logical, with clear connections between adjacent topics; the downside, in retrospect, was that there was too much material and too little guidance in some of the topics, particularly the LV part.

The meetings were intended to be discussions around the literature for a topic that the students would already have read; some questions provided along with the literature would give guidance on what we'd discuss.

Projects were for working on alone or in pairs, outside the course's contact time. They gave wide freedom of how a problem should be solved, leaving the students to choose simplifications, programming or simulation environment, etc. Their solutions were also intended for discussion with everyone together at the end of the project.

Evaluation

This was the first course-round, in a subject not provided at KTH before. It was therefore a big learning experience for

me as the course responsible. Viewpoints were found from informal conversations with students during the course, for example in the break-time of meetings. Two students were also invited to discuss the course after everything including the exam and reporting was finished: they were selected largely by their availability at that time, and by having attended most of the meetings. The following main points were given in these discussions:

Interesting course, good to have the subject and that it promotes MSc theses in this direction.
Concise books were preferable to dispersed material or over-detailed books: the IET books were liked best.
It was good starting with LV: but too much attention was on fuses – include more on other devices.
There were too few lectures (and it would be better to be conventional – just "show lots of slides")
Have "more maths" – concrete calculation problems for each topic
Projects: P1 good, P2 too easy, P3 should be more tightly specified.
Include a lab session with seeing and setting some real modern relays.
Guests: particularly the long guest lecture was very good; others were not so coordinated with the course.
How about a study-visit: substation, or relay factory (Västerås)?

Comments

I intended the meetings would be intensive discussions of course material that had been read in advance. This just didn't happen. No one (except sometimes one student) was willing to speak up, and very little understanding was shown of the course material. The style therefore quickly became more lecture-like, but without well-prepared slides. Possible correctable reasons for the failure of this plan include: too much material, too vaguely defined what to extract from it (especially in the LV part of the course); teacher not confident of what expectations are reasonable as it's a subject we haven't had before; firmer guidance and demands needed when setting the material to study; other techniques needed within meetings to stimulate discussion such as smaller groups or simply forcing students to present specific subjects. Possible reasons less easy to correct include: too little time around other courses; language difficulty making it hard to discuss freely; background knowledge unexpectedly low in some areas (hard to "correct" in limited time).

Looking to students' comments (listed above), I have the following responses.
– Yes: the literature should be refined to a smaller set of clear sources; we might take a single main book next time.
– I'm not convinced yet about being just slide-based: it's lazy (for the students), and I want to get discussions going, as well as training the ability to read different types of sources and extract and organize information.
– The LV part does need to be refined too, which should include more about MCCB/MCB of various vintages.
– We should have more meetings: it was hard this time, as we started with no scheduled slots and had to fit them in.
– More calculations: yes, there should be – but when people can't explain and discuss principles in their own words and equations/diagrams, I wonder whether they should yet be moving on to plugging things into familiar equations. We must be careful to use calculation examples to practise the conceptual skills, not just as an easy way for students to learn procedures for exam-success. The aim of the course is about concepts more than about direct training for being settings-engineers.
– An attempt at arranging a study-visit to a transmission relay factory was not successful this time: a better contact person, inside the organization, is needed if this is to succeed.
– A lab with relay settings sounds a good idea. I wanted to focus on principles and applications – another course in the ICS (industrial control-systems) department does a good job of modern relay communications, substation automation, etc. We could easily have overlap or move this course too much into the details of today's settings programs and menus. But I think the overall effect would be very positive, if a lab task were designed to show some of the range of settings, and let students test some different ones with a real-time simulator or relay test-set.
– My opinion of project tasks was the same. The final one should be more highly specified, to give easier comparison and discussion and to make it easier to get started. We might drop or replace the middle one.

Summary
For a new course in a rather niche subject we had a good number of students.
Several students now have MSc theses in related subjects, obtained through the course.
It feels a worthwhile effort to have started this course; a lot of improvement is possible over the next years.

Plan for 2015
Refine the course literature: consider a single paper book (Paithankar & Bhide ?) as the main source?
Specify ProjectC more tightly. Possibly remove ProjectB, using only as an optional exercise after the guest lecture.
Get adequate sessions into the scheduling system to ensure at least 2 x 2h available per week.
Book similar guests, early.
Discuss with industry and other departments about possible tour and lab-session.