Course Analysis

EI2439 Power System Protection 6p

HT19 P1 / P2 (Sep 2019 - Dec 2019, exam Jan 2020)

Organization

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

19 students took the course.
15 passed the exam at the ordinary time in January.
1 more passed later by Fx completion.
3 more passed at the re-exam, having for timing reasons not taken the ordinary exam.
The exam grades, after one Fx-completion and the re-exam, were:

A (3) B (5) C (4) D (2) E (5).

All who passed the exam also completed the project work, so got the same whole-course grades.

Events

Meetings: 14 double-period sessions, one per week.
Guest lectures: Peter Olsson & Stefan Larsson [Vattenfall], Anna Pettersson [SvK], and Jianping Wang [ABB]

Course material

Intended to be as in 2016-2018: main books *Fundamentals of Power System Protection (*Paithankar and Bhide) and *Network Protection and Automation Guide* (GE Relays), with further sources and our own material to cover gaps are provided on the course webpage, along with tasks, solutions, and old exams. This year there was a trouble ordering enough paper copies of the first book, so pdfs of a subset of its chapters were used, and some books were obtained for students who wanted them later in the course.

Structure

There were again 14 meetings.
The structure of topics changed just a little from 2018.

Introduction
Overcurrent Protection (LV)
LV continued: shock protection
Into MV/HV: Current and Voltage 'transducers'
System Basics and System Earthing in MV (and HV)
MV system overcurrent protection
Symmetric faults, including with Synchronous Machine
Asymmetric faults
Relay implementation
Line differential protection
Line distance protection
Other plant: Busbars, Transformers and Machines
[Project presentations]
Summary and Future (LVDC, HVDC, WAPS, etc).

The main change from 2018 is that in the absence of the lab task, transformer protection has been put together with busbars and machines in a very small, superficial topic to "show some basic issues of these types and make some terms familiar", leaving the final topic for future trends, and letting lines be the focus of the transmission part of the course: as mentioned in the 2018 analysis, lines are considered to take the most attention in transmission protection. As in 2018 also, one week was dedicated to finishing and presenting the main project task.

Tasks

The lab that was intended to be run was cancelled, because of faulty equipment and lack of time to obtain new.

The tasks from 2018 were kept, and were augmented to 12, to cover each week except the introduction and end. (In fact, “MV system…” topic had none, but “Symmetric faults” had two - the machine-fault simulation from last year, and programming a single-line-diagram solution for fault currents.)

The project from last year, line-differential protection implementation, was made into a single home-task in a simplified form, to introduce students to some methods that could be useful in the bigger project task itself. The project task this year was about distance protection, as in the first years. One reason for the change was to reduce problems of not coping with the project due to insufficient programming familiarity; another was to avoid previous years’ solutions being unduly helpful to those who could get them.

Comments from my observations and discussion at the final class

A few students mentioned the high load and stress caused by regular tasks and project in combination with various other courses. However, there were already efforts to coordinate by making the main project work avoid the times that students warned would be intense when we discussed this near the course start. It seems one problem was other courses that changed their tasks. Experience suggests it’s futile to work hard on this, as several other courses are involved, and it won’t be possible to satisfy all the constraints. Example: in 2018 there came several requests about changing the January exam date and time, because of clashes or proximity to other exams in 2nd and even 1st year MSc courses; after two schedule-changes made during the autumn term, each done after checking by email with all students on the course, there still came a comment after the exam saying that the proximity to another exam the following morning was very ‘insensitive’. Fortunately we now cannot change exams. The same is probably wise with tasks: set, and keep. Other courses are reported as sometimes changing their own times which is something we can’t keep adapting to.

Slow feedback on most tasks was noted. This was definitely suboptimal, and a consequence of a considerably larger gorup than expected. We will prioritize “rapid, even if rather light” feedback next time, leaving students to check against the solutions for themselves if wanting to understand an error.

The books were again considered good for the purpose, as long as the paper one is available.

The idea of slides is still suggested. I see some benefits, for me too. Now that we’re getting close to an established structure, it makes more sense. I am still not very content with the distribution of topics or the style and level in each, but slides could be moved around a bit to accomodate changes. Not expected for next year, but perhaps the next.

The guest lectures were appreciated by those who attended. The attendance rate from students on this course was shockingly bad for the presentation from a company that was new this year (Vattenfall) and whose representatives did a really good job of describing their work and their system. Fortunately there were a few other students from the program who also attended in response to the open invitation. Attendance may be required or merited next time. Inclusion of some of the points as questions in the exam is a related option.

Plan for 2020

Check availability of the primary book (paper form) early, or look for electronic option. It is not available in its entirety through proper channels such as KTHB, as it appears to be a book mainly used in India. We should be prepared to change to one or two other books: there may be advantages to looking again at what’s available.

It’s very hard to know what to do about tasks and work-load, in view of a few complaints about this. Since several students considered it not to be a problem at all, I think we should not reduce the level or number available, but should make it easier to skip a few without consequence. I.e. be able to pass PRO1 with a subset, but the learning that’s useful for the exam will still have to be done later. Another option is to make PRO1 be A-F, so that there’s an incentive to do more tasks, well, but several can safely be missed without failing the course. Then students can decide when the demands from other courses are too much to make it worthwhile doing a week’s task.

Availability of lab for the usual real-time simulator hardware-in-loop task with a relay: adapt the task to suit available hardware (relay), or get new hardware, or consider an alternative such as the ‘digital twin’ (Siemens relays).

Try to get similar guests again. Ensure good attendance of their visits: e.g. have examinable content brought up in the presentations, or simply require 2 of 3 attendances or give a little project-credit based on attendance.