Course Analysis

EI2439 Power System Protection 6p

HT18 P1 / P2 (Sep 2018 - Dec 2018, exam Jan 2019)

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

9 students took the course.
The exam grades were

A (2) B (3) C (1) D (3).

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: Jianping Wang [ABB]

Course material

As in 2016/2017.
The main sources are

Fundamentals of Power System Protection (Paithankar and Bhide)
Network Protection and Automation Guide (GE Relays)

Further sources and our own material to cover gaps are provided on the course webpage.
This webpage also has tasks, solutions, and old exams.

Structure

There were again 14 meetings.
The structure of topics was still quite similar to recent years, but small changes make it worth showing this year's exact sequence of weekly focus:

Introduction
Overcurrent Protection (LV)
LV continued: shock protection
Into MV/HV: Current and Voltage 'transducers'
System Basics and System Earthing in MV (and HV)
Symmetric faults, including with Synchronous Machine
Asymmetric faults
MV lines
Transformer protection
Relay implementation
Line differential protection
Line distance protection
[Project presentations]
Miscellaneous: Busbar, Generator, Future things ([HMV]VDC, WAPS, etc).

Note that one week is dedicated to finishing and presenting the main project task.

In an attempt to reduce some subjects in order to have a bit more focus on others, the topics of busbar and generator protection were just very briefly discussed in the final week, in order to give an idea of some of the issues, even though each could have occupied weeks if given the chance. This allows line-protection to get more focus: it is acknowledged by our industry contacts as the part that gets the biggest share of time in practice.

Tasks

The lab task similar to 2016 (missed in 2017) was run again this year, and again was much liked.

The new tasks introduced in 2017 were kept.

Two other tasks were introduced:

analytic calculations with different neutral-treatment typical of medium-voltage systems,
simulation of fault current near a generator, where I provided the basic Simulink model to start from.

The project was the same application as last year: line-differential protection implementation.

Comments from my observations and evaluation comments

Three responses were received on the web-form after the course (33% response rate!).

Their main points were:

The books are good and suitable

The project was useful, but its peer-review session not very giving because of the level of the other group.

Suggestion: tasks with more design problems rather than mainly calculations and reinforcing concepts.

Good that the teacher stayed after classes (which sometimes ended earlier than 2 periods) to answer further questions.

Project tasks are good for keeping up to speed with the course, but did make it demanding: however, they're 'a necessary evil' and the reason for passing and getting good understanding.

Some topics felt weakly connected, 'messy', but it all came together in final revision.

There were not any students with unsuitable prerequisites (c.f. 2017), but a broad spread was seen in the interest and performance of the students: a few chose the subject as a great interest, and worked very hard in all the parts; and a few had it mainly to pass, as one of the less core courses in their selection. The only little trouble this difference posed was that I felt that there was no way of presenting a topic so as to make it both interesting and accessible to all.

Some algorithms developed in the projects had problems that had to be addressed after the peer review, since they had clear failings to perform in the desired way.

Several students thought that more lab-type work would be pleasant, but this wasn't unanimous - perhaps the one lab task is enough.

Simulink, particularly in the first task (asymmetric fault current) was considered unduly difficult to get started with, even for a simple problem. It may be worth providing guidance or a working example, even if that sounds as if it shouldn't be needed at this stage in the MSc program.

Plan for 2019

Much the same.

Aim for task-per-week (slightly more). Review tasks for too easy/hard.

Keep the usual guest lectures from the relay manufacturer, ABB.

Get a guest from transmission utility SvK (try Anna again, as in 2017), and try to get a distribution-utility engineer too.

Keep the lab, or split into two (more content) if we can implement and test that in time.