



FEH3250 Power System Automation 6.0 credits

Kraftsystemautomation

This is a translation of the Swedish, legally binding, course syllabus.

Establishment

Course syllabus for FEH3250 valid from Spring 2017

Grading scale

G

Education cycle

Third cycle

Specific prerequisites

Admitted to PhD program at KTH.

Language of instruction

The language of instruction is specified in the course offering information in the course catalogue.

Intended learning outcomes

After completing the course, the participants should be able to:

- Analyse the new requirements facing transmission and distribution grids with a focus on automation and protection functions.
- Design automation functions for distribution grids, including for instance interlocking, switching schemes and protection.
- Create substation automation system architectures using the Substation Configuration Language.
- Interface automation devices with realtime simulators to evaluate protection settings against typical power system faults (over current, three phase fault, transformer internal fault)
- Analyse cybersecurity threats to substation automation systems and design appropriate detection and protection mechanisms.

Course contents

The course consists of lectures, substation automation system (SAS) design assignment and communication system design and evaluation. In addition, participants will perform an individual project in a field within the course scope.

Disposition

Lectures

The course has 8 lectures, covering the following topics:

L1

Substation Engineering & Protection system design

Lars Nordström

L2

Substation Automation System Architectures

Lars Nordström

L3

Substation Communication Systems

Lars Nordström

L4

Substation Configuration Language

Lars Nordström

L5

Cybersecurity for Substation systems

Mathias Ekstedt

L6

IEC 61850 developments

Karl-Heinz Schwarz

L7

Functional block programming and IEC 61850 station development

Lars Nordström

L8

Substation architecture reliability analysis using PRMs

Lars Nordström

As preparation, participants will be asked to read relevant parts of the course literature, information about exact content will be given during the course.

SAS assignment

The participants will design a substation automation system using both software tools for architecture design and hardware devices, which must be interoperable to perform the necessary automation functions. The students are divided into groups, and potential functions to implement are: Interlocking, Automated Busbar switchover, and breaker maintenance switching.

Communication system design

The students will analyse communication needs and suggest a communication system, including security mechanisms, for the substation automation system. The system shall be implemented as models in the OPNET communication system simulator, and performance of the system under various fault conditions shall be evaluated.

Individual project

The participants are tasked to design a research project into fields related to the course topics, suggested areas include:

1. Semantic models for data look up and identification in substation systems
2. Performance assessment of data encryption techniques in substation communication
3. Cybersecurity intrusion detection for substations.
4. Functional mapping of logical node interfaces

The work shall include definition of a research project in the area, including a literature review of related work in the field.

Course literature

The following literature is mandatory reading, and in addition a selection of reference documents from the IEC 61850 standard will be used.

- [1] Substation Automation Handbook. Dr. Klaus-Peter Brand, Volker Lohmann, Dr. Wolfgang Wimmer, NettedAutomation.
- [2] Electric Power Substation Engineering. John D McDonald (ed), ISBN:978-0849373831
- [3] IEC 61850-7 Browsable models.pdf Karl-Heinz Schwarz.
- [4] Modelling and Object Oriented Implementation of IEC 61850: The New International Standard on Substation Communications and Automation, C Ozansoy, ISBN:978-3838358482

Equipment

None.

Examination

Based on recommendation from KTH's coordinator for disabilities, the examiner will decide how to adapt an examination for students with documented disability.

The examiner may apply another examination format when re-examining individual students.

If the course is discontinued, students may request to be examined during the following two academic years.

Other requirements for final grade

Complete all three course components with a passing grade.

Ethical approach

- All members of a group are responsible for the group's work.
- In any assessment, every student shall honestly disclose any help received and sources used.
- In an oral assessment, every student shall be able to present and answer questions about the entire assignment and solution.