EI2439 Power System Protection 6.0 credits

Skyddssystem i elkraftsystem

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

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

Establishment

Course syllabus for EI2439 valid from Autumn 2014

Grading scale

A, B, C, D, E, FX, F

Education cycle

Second cycle

Main field of study

Electrical Engineering

Specific prerequisites

120 hp and English B or equivalent. Knowledge corresponding to EI2436 Power Grid Technology and Substation Design,EG2100 Power System Analysis,EH2741 Communications and Control in Power Systems.

Corresponding background knowledge from work can be accepted by agreement in individual cases.

Language of instruction

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

Intended learning outcomes

The following are the main abilities that the course is designed to teach and assess in the sessions, projects and exam:

- Explain the purposes of protection, in relation to major types of apparatus, protection principle, dangers and criteria.
- Choose and justify a suitable protection system for a specified application.
- Analyze and compare specified protection systems.
- Compare merits of various principles, relay hardware and interrupting devices.
- Perform calculations relevant to algorithms and apparatus used in modern protection systems.

The course provides useful background knowledge and trains analytical skills for several potential career paths for Electric Power MSc graduates.

The subject is an important one within modern power systems, and is becoming especially relevant in distribution networks with growing amounts of generation. It forms a bridge between the power components, power-system control, and power-system information/communication technology (ICT). The course's content would be of direct application for work with protection in a utility or at a manufacturer of protection equipment; it is also useful background for anyone studying system stability or being responsible for items of equipment such as transformers or generators.

Course contents

The core content considers the following:

- Purpose and desiderata for protection-systems: limit damage to people, components, external property, and system operation, while isolating as little as necessary. Modern-day changes in grid components and operation: implications for protection systems.
- Apparatus and fault-types: repetition and extension of content of the Power Grid Technology course, e.g. arcing faults in lines, cable faults, faults in transformers and even rotating machines.
- Theoretical aspects. Measured phenomena that can indicate presence of a fault, for various types of apparatus. Generic decision-making schemes that can use such phenomena to provide a protection system fulfilling requirements such as speed, reliability, security, etc.
- Practical details for implementing protection with present and past technology. Measurements at high voltage: voltage transformers and current transformers and their inidealities. Decision-making devices: electromechanical relays, [analog-]electronic relays and digital relays (IEDs).

- Interruption. Recap on circuit-breaker types from Power Grid Technology; deeper about the interruption properties of different types of circuit (and breaker). Overview of fuses as a combined detection/interruption device, mainly at the lower end of power-system voltages.
- Present and future developments in Protection. Wide-area measurement and control (and protection). New measurement-transducers, communication methods, calculation hardware. System-integrity protection systems (SIPS) going beyond component-oriented protection.

Disposition

The course is based on reading and project work, with some seminars and a small number of lectures, some of which are from industrial experts. The first half of the course considers some core background of the subject, and the second half gives more opportunity for students to choose work that fits with their specific interests: these might be in areas as diverse as the choice of protection for best integration of wind generators in a distribution network, or the protection of generator windings, or application of “system-integrity protection systems” at the transmission level.

Course literature

No particular book is required. A specialised set of notes will be provided. Various papers and excerpts from books and articles are also used; all will be provided or available electronically through the KTH library or public websites.

Examination

- PRO1 - Project Work, 3.0 credits, grading scale: P, F
- TEN1 - Written Examination, 3.0 credits, grading scale: A, B, C, D, E, FX, F

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.

Other requirements for final grade

Approved projects and passed final examination.

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.