DESCRIPTION OF THE COURSES

- Course code: ELR2109
- Course title: POWER SYSTEM FAULTS
- Language of the lecturer: English

Course form	***Lecture***	***Classes***	***Laboratory***	***Project***	***Seminar***
*Number of hours/week**	*2*			*1*	
*Number of hours/semester**	*30*			*15*	
Form of the course completion	*Exam*			*Pass*	
ECTS credits	*4*			*2*	
Total Student's Workload	*120*			*60*	

- Level of the course (basic/advanced):): basic
- Prerequisites:
  completed course: -
- Name, first name and degree of the lecturer/supervisor:
  Jan Iżykowski, Ph. D., D. Sc.
- Names, first names and degrees of the team's members:
  Eugeniusz Rosołowski, Prof., Ph. D., D. Sc.
- Year: 4 Semester: 7
- Type of the course (obligatory/optional): obligatory
- Aims of the course (effects of the course):
  Gain of basic knowledge with respect to power system faults and basic information on the devices such as digital fault recorders and fault locators. Deep familiarization with different problems of power system faults analysis.
- Form of the teaching (traditional/e-learning): traditional
- Course description:
  The course consists of the lecture and project. **The lecture** deals with different aspects of power system faults. Fault causes and effects together with classification of faults and analysis of typical fault current wave-shape are delivered in the introduction. Then, the aims of fault calculations and use of per units are specified. The methods used in fault analysis are described. In particular it is focused on symmetrical component method for which equivalent diagrams of power system components are described and then symmetrical and unsymmetrical faults in systems solidly grounded are analysed. Ground faults in networks with: isolated neutral point, neutral point earthed by the compensation reactor and neutral point earthed by the resistor are described. Reference of short-circuit calculations to the present standard is given. Basic characteristic of the devices: digital fault recorder and digital fault locator are delivered. Main issues relevant for transformation of fault currents and voltages by instrument transformers are characterized. During **the project** students complete individual tasks aimed at deep familiarization with the specific problems of power system faults analysis.
- Lecture:

Particular lectures contents	*Number of hours*

1. Fault causes and effects, classification of faults, typical fault current wave-shape.	2
2. Aims of fault calculations, use of per units in calculations.	1
3. Method of symmetrical components.	1
4. Modal transformations, phase co-ordinates approach.	2
5. Equivalent diagrams of synchronous generators for symmetrical components.	1
6. Equivalent diagrams of power transformers for symmetrical components.	2
7. Equivalent diagrams of overhead lines and cables for symmetrical components.	2
8. Analysis of three-phase symmetrical faults.	2
9. Analysis of single phase-to-ground faults.	2
10. Analysis of phase-to-phase faults.	1
11. Analysis of phase-to-phase-to-ground faults.	1
12. Analysis of open conductor failure and open conductor failure combined with single phase-to-ground fault.	1
13. Ground faults in networks with isolated neutral point.	2
14. Ground faults in networks with neutral point earthed by the compensation reactor.	2
15. Ground faults in networks with neutral point earthed by the resistor.	1
16. Specification of short-circuit calculations by the international standard.	2
17. Digital fault recorders – basics of application, typical digital fault recorder configuration.	1
18. Digital fault locators – basics of application, fault location versus protection, application of different input data measurements.	2
19. Transformation of fault currents and voltages by instrument transformers.	2

- Classes – the contents:
- Seminars – the contents:
- Laboratory – the contents:
- Project – the contents:

  During **the project** students complete individual tasks aimed at deep familiarization with the specific problems of power system faults analysis. In particular, students have to perform the fault current analysis for the specified network. It is expected that Matlab will be used for certain calculations.
- Basic literature:

[1] J. D. Glover, M. Sarma: Power system analysis and design, PWS Publishing Company Boston, second edition, 1994.

[2] J. L. Blackburn: Symmetrical components for power systems engineering, Marcel Dekker, New York 1993, Serie: Electrical Engineering and Electronics 85.

[3] J-P. Barret, P. Bornard, B. Meyer: Power system simulation: Chapman and Hall, London 1997.

[4] P. M. Anderson: Power system protection, IEEE Press, Power Engineering Series, New York 1999.

[5] H. Ungrad, W. Winkler, A. Wiszniewski: Protection techniques in electrical energy systems, Marcel Dekker Inc. New York, Basel, Hong Kong, 1995.

- Additional literature:

- Conditions of the course acceptance/credition:

***** - depending on a system of studies