COURSE DESCRIPTION CARD - SYLLABUS

Course name
Safety control engineering in electrical grid and in power plants [N1Energ2>AZwSiE]

Course

Field of study
Power Engineering

Year/Semester
3/6

Area of study (specialization)
–

Profile of study
general academic

Level of study
first-cycle

Course offered in
Polish

Form of study
part-time

Requirements
compulsory

Number of hours

Lecture
20

Laboratory classes
20

Other (e.g. online)
0

Tutorials
0

Projects/seminars
0

Number of credit points

4,00

Coordinators

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Lecturers

Prerequisites

Basic knowledge within the scope of electrical engineering, electrical power engineering and electrical power systems and networks. Ability to effective self-studying in the domain connected with chosen course of studying, abilityto use computer simulation to evaluate performance of elements of power system. Has a consciousness of necessity to widen competences and willingness to work in a team.

Course objective

The objective is to acquaint with basic tasks and technical solutions of electric power system protection (EAZ) in electric power systems.

Course-related learning outcomes

Knowledge:
1. Has a structured knowledge of the basics of control and automation of technological processes in power engineering, knows and understands the construction, principles of operation, application and design of protection automation systems (including specialised ones), as well as stability problems in dynamic systems.
2. Has advanced and established knowledge of the construction, operation and diagnostics of power

equipment, machines, installations and networks, as well as of complex methods, technologies, conditions for their assembly, commissioning and disassembly - including for non-standard solutions, knows and understands methods of measurement of basic quantities characterising power, mechanical and electrical equipment and systems, knows calculation methods and IT tools necessary for the analysis of experimental results.
3. He has a systematic knowledge of programming techniques and methods of simulating phenomena in energy systems in the aspect of energy security issues, in particular methods of forecasting energy demand, existing threats and ways of increasing the level of energy security on a regional and national scale; he knows the basic principles of creating and developing various forms of entrepreneurship, including individual entrepreneurship.

Skills:
1. He/she is able to obtain information from literature, databases and other sources and integrate the information obtained, interpret, evaluate, critically analyse and synthesise it in order to draw appropriate conclusions and formulate and issue opinions defining the conditions and technologies for the installation of both typical and atypical energy equipment and installations, as well as the conditions and technologies for the construction of power transmission networks.
2. He/she is able to use appropriately selected programming environments, simulators and computer tools in the development of control automation system operation programmes and in the design and simulation of the operation of equipment, installations, power systems and networks and simple electronic systems.
3. He/she is able to carry out the assembly, commissioning and disassembly of power equipment, installations and networks, using appropriately selected methods, equipment and information technology diagnose the causes of malfunctions, failures or disturbances in the operating state, as well as plan and carry out work related to their inspection, overhaul, repair and modernisation under various conditions.

Social competences:
1. He/she is aware of the need to initiate changes both in the working environment and for the public interest, related to the implementation of new technologies and technical and organisational solutions in the energy sector.
2. He/she is aware of the responsibility for his/her own work and of his/her willingness to follow the rules of teamwork and to take responsibility for his/her professional role in jointly carried out activities for the improvement of safety and quality at work, the improvement of the quality of manufactured products and services and tasks performed in energy-related processes.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Lecture:
- evaluation of the knowledge and competitions on written exam (problem character), pass threshold: 50% of the total possible points,
- rewarding activity and quality of perception.
Laboratory:
- written colloquium at the end of laboratory classes, pass threshold: 50% of the total possible points,
- rewarding the knowledge necessary for realization of problems connected with laboratory tasks,
- evaluation of reports on laboratory exercises carried out (min. 1 report per semester).
- premise the knowledge necessary to carry out problems on specific laboratory tasks,
- rewarding the incremental skills in the use of known research methods.

Programme content

The course content is concerned with basic and advanced issues of electric power protection automation (EAZ) and measurements of electrical and non-electrical quantities used in EAZ. The subject is related to power system protection in distribution, transmission and generation systems.

Course topics

Lectures:
Tasks and functions of elements of electric power system protection (EAZ), VT's, CT's, digital technology,

protection systems for generators, transformers and lines. Power system automation: SPZ, SCO, SZR. Modern solutions of EAZ systems used in power system and basics of selection of settings.
Laboratory:
Laboratory classes related to investigation of basic protections (relays) using basic measurement devices and of it's autonomic sets and of models of the elements of electric power systems.

Teaching methods

Lectures:
- lecture with multimedia presentation (drawings, photos, videos) supplemented by records on the board,
- interactive lecture with questions to students,
- theory presented in close connection with practice.
Laboratory:
- group work,
- demonstrations,
- detailed review of the reports (by teacher) and discussion of the comments.

Bibliography

Basic:
1. Hoppel W.: Sieci średnich napięć. Automatyka zabezpieczeniowa i ochrona od porażeń. PWN, Warszawa 2017
2. Winkler W., Wiszniewski A.: Automatyka zabezpieczeniowa w systemach elektroenergetycznych, Wyd. II. WNT, Warszawa 2004
3. Szafran J., Wiszniewski A.: Algorytmy pomiarowe i decyzyjne cyfrowej automatyki elektroenergetycznej. WNT, Warszawa 2001
4. Borkiewicz K.: EAZ w sieciach elektroenergetycznych ŚN i WN. ZiAD, Bielsko Biała 2016
5. Anderson P. M., Henville C., Rifaat R., Johnson B., Meliopoulos S.: Power system protection. 2nd edition. Wyd. Wiley, 2022

Additional:
1. Musierowicz K., Staszak B.: Technologie informatyczne w elektroenergetyce. Wyd. PP, Poznań 2010
2. Lorenc J.: Admitancyjne zabezpieczenie ziemnozwarciowe. Wyd. PP, Poznań 2007
3. Hoppel W., Olejnik B.: Elektroenergetyczna automatyka zabezpieczeniowa dla sieci średniego napięcia zelektrowniami lokalnymi. INPE miesięcznik Stowarzyszenia Elektryków Polskich, nr 177/2014
4. Zięba B., Olejnik B., Grobelna I.: Application of under-impedance criterion to protect against effects of phase-to-phase short circuit in medium voltage networks. Energies, vol. 17, iss. 2, 2024
5. Olejnik B.: Ocena skuteczności wybranych kryteriów identyfikacji zakłóceń ziemnozwarciowych implementowanych w urządzeniach EAZ w głębi sieci SN. elektro.info, nr 7-8/2023
6. Andruszkiewicz J., Lorenc J., Olejnik B., Weychan A., Staszak B.: Method of reducing the effects of repeated ignition during earth faults in compensated medium voltage networks. Energies, vol. 17, iss. 1, 2024
7. Andruszkiewicz J., Lorenc J., Staszak B., Weychan A., Zięba B.: Overcurrent protection against multi-phase faults in MV networks based on negative and zero sequence cruteria. International Journal of Electrical Power & Energy Systems, 2022, vol. 134.

Breakdown of average student's workload

	Hours	ECTS
Total workload	110	4,00
Classes requiring direct contact with the teacher	40	1,50
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	70	2,50