



COURSE DESCRIPTION CARD - SYLLABUS

Course name

Indoor stations and switchboards [S2Elenerg1-UEE>SWiR]

Course

Field of study	Year/Semester
Electrical Power Engineering	1/2
Area of study (specialization)	Profile of study
Electric Energy Exploitation	general academic
Level of study	Course offered in
second-cycle	Polish
Form of study	Requirements
full-time	compulsory

Number of hours

Lecture	Laboratory classes	Other (e.g. online)
15	15	0
Tutorials	Projects/seminars	
0	15	

Number of credit points

3,00

Coordinators

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Lecturers

Prerequisites

Basic knowledge of electrical circuits and devices. Knowledge of measuring equipment and its use. The ability to interpret the phenomena accompanying the flow of electricity in devices and power installations. Ability to follow and analyze issues contained in regulations, standards and subject literature. Awareness of the necessity of lifelong learning.

Course objective

Getting to know the structure and basic equipment of power stations. Acquisition of knowledge in the field of thermal and electrodynamic phenomena accompanying the flow of working and fault currents in power devices. Obtaining extended knowledge about the phenomena occurring in metallic and arc high-current short-circuits and methods of limiting their effects. Acquisition of skills related to the design of basic circuits of power stations and switchgears and the selection of their equipment.

Course-related learning outcomes

Knowledge:

student has a well-established knowledge of the work systems of power substations and the purpose, construction and equipment of indoor switchgears of electric power distribution stations. student has

an extensive knowledge of the operation and diagnostics of indoor stations and switchboards. student has a well-established knowledge of the purpose and construction of switchgear. student has limiting their effects.

Skills:

student is able to rationally assess the risk caused by short-circuit currents and arc faults and analyze the solutions of power systems and devices from the point of view of their operating parameters and investment costs. student is able to prepare and verify the technical, economic and environmental power supply design of the selected facility. student is able to interact with designers of other installation systems and users of building structures.

Social competences:

student is aware of the threats occurring in the operated electrical power equipment caused by emergency states and the need to limit them in order to maintain operational safety. student is aware of the responsibility for the safety of users of electrical power devices.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

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Lecture:

- knowledge acquired as part of the lecture is verified by a written final test consisting of open or test questions with different points. Passing threshold: 50% of points,
- current grading in each lecture (rewarding activities).

Laboratory classes:

- current check and rewarding knowledge necessary for the accomplishment of the problems in the area of laboratory tasks,
- evaluation of reports performed on laboratory classes,
- rewarding activities related to the implementation of laboratory classes.

Projects:

- the preparation of materials for the project is evaluated,
- substantive preparation for the implementation of the assigned project is evaluated,
- project and its defense are evaluated.

Programme content

Lecture:

Indoor stations and switchboards, construction, equipment, purpose of use. Metallic and arc faults.

Laboratories:

Exercises related to the automation of the "Automatic Reserve Switching System (SZR)" and automatic re-closing (SPZ).

Projects:

Independent project in the field of design and construction of indoor stations and switchboards.

Course topics

Lecture:

- Overview of power stations for industrial facilities.
- Busbar systems in low and medium voltage stations.
- Characteristics of MV and LV switchboards.
- Construction and parameters of distribution devices.
- Causes and effects of metallic and arc faults.
- Methods of limiting the effects of short circuits.
- Impact of an emergency electric arc.
- Arc protection issues.
- Methods of eliminating the emergency arc.

Laboratories:

- Overview of the classes: topics, literature, requirements, reports, health and safety
- Automation of the "Automatic Reserve Switching System (SZR)" based on PLC controllers,
- Using a PLC controller, implementation of the AS automation module in a network-network configuration,
- Using a PLC controller, implementation of the ATS automation module in the network - network - clutch configuration,
- Using a PLC controller, implementation of the AS automation module in the network-generator configuration,
- Automatic re-closing (AVS),
- Summary of classes, reports and assessment

Projects:

The assigned project in the field of indoor stations and switchgears, including output data, design diagrams, substitute diagrams and technical calculations, is to be completed.

Teaching methods

Lecture:

- multimedia or object-oriented presentations supported by illustrated examples presented on the board,
- interactive lecture with questions and initiating discussions.

Laboratory classes:

- object-oriented presentations supported by illustrated examples presented on the board,
- presentations of selected experiments,
- initiating teamwork.

Projects:

- use of dedicated or developed computer applications as well as graphic programs and catalogs of manufacturers of electrical devices, switchgear, prefabricated switchboards and installation accessories.

Bibliography

Basic

1. Markiewicz, H. Urządzenia elektroenergetyczne, WNT, Warszawa, 2006.
2. Markiewicz, H. Bezpieczeństwo w elektroenergetyce, WNT, Warszawa, 2017.
3. Kamińska, A. Urządzenia i stacje elektroenergetyczne, Wydawnictwo Politechniki Poznańskiej, 2000.
4. Maksymiuk, J., Nowicki, J. Aparaty elektryczne i rozdzielnice wysokich i średnich napięć, Wydawnictwo Politechniki Warszawskiej, Warszawa, 2014.
5. Żmuda, K. Elektroenergetyczne układy przesyłowe i rozdzielcze. Wybrane zagadnienia z przykładami, Wydawnictwo Politechniki Śląskiej, 2014.
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7. Koch B., Maksymiuk J.: Łukoodporność rozdzielnic osłoniętych i symulacja zwarć łukowych, Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa, 2007.
8. Maksymiuk J., Pochanke Z.: Obliczenia i badania diagnostyczne aparatury rozdzielczej, wyd.1, WNT, 2001.
9. Maksymiuk J.: Niezawodność maszyn i urządzeń elektrycznych, Oficyna Wydawnicza PW, 2003.
10. Turowski, J.: Elektrodynamika techniczna, WNT, Warszawa, 2014.

Additional

1. Au A., Maksymiuk J., Pochanke Z. Podstawy obliczeń aparatów elektroenergetycznych. WNT, Warszawa, 1982.
2. Glover, J. D., Sarma, M.S., Overbye, T.J. Power System Analysis and Design, cengage Learning, Inc, Florence, KY, US, 2011
3. Wasiak, I. Elektroenergetyka w zakresie Przesył i rozdział energii elektrycznej, Politechnika Łódzka, 2010.
4. Nowak, K.; Janiszewski, J.; Dombek, G. The possibilities to reduce arc flash exposure with arc fault eliminators. Energies. 2021, vol. 14, no. 7, pp. 1927-1-1927-25.
5. Nowak, K.; Janiszewski, J.; Dombek, G. A multi-sectional arc eliminator for protection of low voltage electrical equipment. Energies, 2020, vol. 13, no. 3, pp. 605-1-605-20.
6. Nowak, K.; Janiszewski, J.; Dombek, G. Thyristor arc eliminator for protection of low voltage electrical equipment. Energies, 2019, vol. 12, no. 14, pp.2749-1-2749-15.
7. Książkiewicz, A.; Dombek, G.; Nowak, K. Change in electric contact resistance of low-voltage relays affected by fault current. Materials, 2019, vol. 12, no. 20, pp. 3926-1-3926-13.

8. Maksymiuk, J. Aparaty elektryczne. Podstawy doboru i eksploatacji. WNT, Warszawa, 1977.
9. Normy przedmiotowe.
10. Publikacje internetowe.

Breakdown of average student's workload

	Hours	ECTS
Total workload	84	3,00
Classes requiring direct contact with the teacher	45	1,50
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	39	1,50