COURSE DESCRIPTION CARD - SYLLABUS

Course name
Power system operation [N1Energ2>PSE]

Course

Field of study
Power Engineering

Year/Semester
5/9

Area of study (specialization)
–

Profile of study
general academic

Level of study
first-cycle

Course offered in
Polish

Form of study
part-time

Requirements
elective

Number of hours

Lecture
20

Laboratory classes
10

Other
0

Tutorials
0

Projects/seminars
10

Number of credit points

5,00

Coordinators

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Lecturers

Prerequisites

Knowledge: Has basic knowledge of the theory of electrical circuits, electrical machines, power engineering and electricity generation Skills: Has the ability to effectively self-study in a field related to the chosen specialization, combine knowledge acquired in the course of previously completed subjects Competences: Is aware of the need to expand their knowledge and competences, readiness to cooperate and cooperate in a group

Course objective

Familiarization with the operation of the power system under steady-state operating conditions. Methods of simulation calculations of power distributions in closed networks of high and highest voltages. Optimization of power distributions under market conditions. Voltage and frequency regulation in the power system. Operation of the neutral point of MV, HV and EHV networks. Stability of the electric power system. Practical operation of programs for power distribution calculations and short circuit calculations. Familiarization with the operation of the power system under transient operating states. The problems of studying the stability of the power system under small disturbances and temporary large disturbances of the active power balance.

Course-related learning outcomes

Knowledge:
Has a structured knowledge of the basics of control and automation of technological processes in the power industry, knows and understands the construction, principles of operation, application and design of protection automation systems (including specialized), as well as stability problems in dynamic systems.
Has advanced knowledge of selected facts, objects and phenomena, as well as the methods and theories concerning them that explain the complex relationships between them, constituting basic knowledge of the fundamentals of electric power engineering, and knows and understands how the national energy system operates, including the principles of developing applicable energy tariffs and price lists.
Has a structured knowledge of programming techniques and methods of simulation of phenomena in energy systems in the aspect of energy security issues, in particular, methods of forecasting energy demand, existing threats and ways to increase the level of energy security on a regional and national scale, knows the basic principles of creation and development of various forms of entrepreneurship, including individual.

Skills:
Is able to use the learned analytical, simulation and experimental methods, as well as mathematical models and computer simulations to analyze and evaluate the performance of energy components and systems, as well as to develop plans to ensure the continuity of energy generation and supply in various operating states of energy equipment and installations, and energy security in power grids.
Is able to identify and formulate specifications for simple engineering tasks of a practical nature in the field of energy, including optimizing the consumption of energy produced from renewable and non-renewable energy sources and designing an energy recovery system for industrial processes.

Social competences:
Is aware of the need to initiate changes both in the work environment and for the public interest, related to the implementation of new technologies and technical and organizational solutions in the energy industry.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Lectures: Evaluation in class (premium on activity and quality of perception), evaluation of knowledge and skills demonstrated on the written exam in the examination session. The exam is problem-based, the threshold for passing: 50% of the points possible to score.
Laboratory: Tests checking knowledge necessary in the field of laboratory tasks, assessment of knowledge and skills related to the implementation of the exercise task, evaluation of the report of the exercise.
Project: Ongoing assessment of preparation for the implementation of project tasks, assessment of the completed project task.

Programme content

Basic knowledge of the power system. Steady states and transients in the power system. Power flows. Basic quantities in the power system and the relationship between them. Voltage regulation. Frequency regulation. Stability of the power system. Short circuits.

Course topics

Steady states in the electric power system. Optimization of system operation under marketconditions. Calculation of power distributions-role of the nodal potential method. Application ofGaussian and Newton-Raphson iterative methods to solve nonlinear nodal equations. Optimization ofpower distributions. Relationships between basic quantities in the power system. Regulation of voltageand frequency in the NPS.Transients in the electric power system, types of states, disturbances in the system. Scope of researchand analysis of transients. Stability of the electric power system. Small generator rotor swings - localangular stability. Angular characteristics of power. Modes of operation of the neutral point of the MV,HV and EHV networks.Laboratory includes exercises implemented using power distribution programs - PLANS and SCC short-circuit calculations on the issues discussed during lectures.Project_ includes project tasks carried out in accordance with the topics presented in the lectures_

Teaching methods

Lecture: multimedia presentation supplemented with examples given on the board.
Laboratories: Performing tests on physical or digital models in selected computing environments (e.g. PLANS, SCC).
Project: project task carried out in the spirit of the "Problem-based learning" method with the result in the form of a report on the completed task, which is subject to evaluation.

Bibliography

Basic:
1. Kremens Z. , Sobierajski M. : Analiza systemów elektroenergetycznych. WNT, Warszawa, 1996.
2. Kacejko P., Machowski J.: Zwarcia w systemach elektroenergetycznych. WNT, Warszawa, 2002.
3. Machowski J.: Regulacja i stabilność systemu elektroenergetycznego. OWPW, Warszawa 2007.
4. Poradnik Inżyniera Elektryka . t.3. WNT, Warszawa 2005
5. Lubośny Z.: Stabilność systemu elektroenergetycznego. PWN, Warszawa 2018.
6. Chow J.H, Sanchez-Gasca J.: Power system modeling, computation and control, Wiley-IEEE Press, 2020.

Additional:
1. Cegielski M.: Sieci i systemy elektroenergetyczne. PWN, Warszawa, 1979.
2. Machowski J., Białek J., Bumby J. Power System Dynamics: Stability and Control. IEEE Wiley, 2008
3. Anderson P.M., Fouad A.A, McCalley J.D., Vittal V.: Power System Control and Stability. Wiley-IEEE Press, 2019
4. Handke J., Olejnik B., Schott A.: Algorytmy samoczynnego częstotliwośćiowego odciążania w świetle obowiązujących rozporządzeń Komisji Europejskiej. Blackout a krajowy system elektroenergetyczny: Edycja 2018, Poznań 2018
5. Grządzielski I., Olejnik B., Zakrzewski M.: Modeling of transient states in the start-up path during voltage and start-up power application. Archives of Electrical Engineering, 2019, vol. 68, no 4.

Breakdown of average student's workload

	Hours	ECTS
Total workload	142	5,00
Classes requiring direct contact with the teacher	42	1,50
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	100	3,50