COURSE DESCRIPTION CARD - SYLLABUS

Course name
RES in the power system and SCADA systems [N1Energ2>OZEwSE]

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 (e.g. online)
0

Tutorials
0

Projects/seminars
10

Number of credit points

5,00

Coordinators

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Lecturers

Prerequisites

Basic knowledge of electrical engineering, electronics and computer science as well as electricity generation by renewable energy sources. Basics of programming in C, Pascal or another high-level language. Is aware of the need to expand their competences, readiness to cooperate within a team.

Course objective

Familiarization with the specifics of the operation of renewable energy sources in the power system - SE. Rules for connecting RES to SE. Technical solutions for connecting renewable energy sources, PV and FW power plant configurations and their impact on the local functioning of the SE. Security in PV and wind farms. The use of renewable energy in regulatory processes (controlling electricity parameters) in SE. Acquainted with the principles of design, construction and operation of the control and visualization system, configuration of system elements and the possibilities of SCADA environments. Familiarization with the possibility of working in simulation mode and the real object supervised by a PLC controller. Implementation of own design for visualization and control of renewable energy systems cooperating with the energy system. Presentation of current progress and final solution.

Course-related learning outcomes

Knowledge:
1. has elementary knowledge in the field of using IT tools in SCADA systems, programming in dedicated languages, designing signal transmission networks and using databases,
2. has elementary knowledge about the construction, operation principles and selection of PLC controllers (including simulated ones) cooperating with SCADA visualization and control systems,
3. has basic and systematic knowledge in the field of design and programming of microprocessor systems and PLC controllers used in industrial process control,
4. has knowledge of the principles and problems posed by the inclusion of renewable energy sources in the power system.

Skills:
1. is able to formulate a process control algorithm and implement it using appropriate programming languages,
2. can simulate real working conditions and parameters of renewable energy systems cooperating with the energy system using the SCADA system,
3. knows how to correctly select design assumptions and make presentations showing the characteristics of the designed SCADA system,
4. is able to present ways of minimizing the negative effects of the presence of renewable energy sources in the system, with particular emphasis on wind farms and solar farms.

Social competences:
1. is aware of the importance of own and team work, can be responsible for implemented project tasks,
2. is aware of the ecological role of renewable energy sources in shaping the energy policy of the State.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Lecture: assessment of knowledge and skills demonstrated on the written exam of a descriptive / problem nature (checking the ability to use the acquired knowledge). Individual elements assessed according to the points system, 50% of the maximum number of points required to pass.
Skills acquired as part of the laboratory are verified on the basis of: assessing activity during each class, rewarding the increase in the ability to use known principles and methods, verification of skills when passing the project.
Project classes are assessed on the basis of: implementation and presentation of the project visualization and control of the selected process along with project documentation, cooperation skills within the team that practically implements the project task, presentation of current progress in project implementation.

Programme content

Connecting RES to the National Power System: technical and legal requirements, impact of RES on the operation of the National Power System. Characteristics of the SCADA system and practical applications.

Course topics

Lecture:
Requirements for RES in the context of connection to the PPS. Quality of electricity generated by renewable energy sources. Problems related to connecting low and high power renewable energy sources to the National Power System. The impact of renewable energy on the rigidity of the power system. Minimization of threats related to unstable operation of electricity sources in the power system. Formal and legal issues related to the construction and connection of ecological energy sources to the network. Completion and preparation of technical documentation required for connecting RES to the power system. Economic aspects of including renewable energy in the PPS on the medium and high voltage side.
Laboratory:
Configuration of communication with external devices, creating synoptic screens, defining variables, configuring alarms, charts (trends), recording events - logs, programming elements, protecting the system against unauthorized access (users and authorization system configuration), handling events, reports, keyboard shortcuts, work with a real industrial controller and become familiar with other selected elements of the SCADA system. Introducing modern application solutions used in practice.

Project:
Implementation of an individual / team project with current presentation of assumptions and progress in implementation, in the field of visualization and control of renewable energy systems cooperating with the energy system. Using students 'knowledge of other subjects, initiating discussions, asking questions in order to increase students' activity and independence.

Teaching methods

Lecture: lecture with multimedia presentation (including drawings, photos, animations, sound, films) supplemented by examples given on the board, lecture conducted in an interactive way with the formulation of questions for a group of students or specific students indicated, initiating discussions during the lecture, taking into account various aspects of the issues presented, including: economic, ecological, legal, social, etc., presenting a new topic preceded by a reminder of related content known to students in other subjects;
Laboratories: practical knowledge of the functionality and capabilities of the SCADA system, computer classes covering the scope of the topic.
Projects: The use of computer and multimedia equipment with dedicated software to present current progress in the implementation of final projects.

Bibliography

Basic:
1. Cupek R., Metody wizualizacji rozproszonych procesów przemysłowych. Praca doktorska, PŚ, Gliwice, 1998.
2. Marciniak P., Wprowadzenie teoretyczne do systemów SCADA, Self Publishing, 2013.
3. Jakuszewski R., Programowanie systemów SCADA., Gliwice, 2006.
4. Lubośny Z. Elektrownie wiatrowe w systemie elektroenergetycznym, WNT, Warszawa, 2006.
5. Lubośny Z. Farmy wiatrowe w systemie elektroenergetycznym, WNT, Warszawa, 2009.
6. Praca zbiorowa, Gałuszak M., Paruch J. Odnawialne i niekonwencjonalne źródła energii. Poradnik, Wyd. TARBONUS, Tarnobrzeg, 2008.
7. Klugmann-Radziemska E. Fotowoltaika w teorii i praktyce, Wydawnictwo BTC, Legionowo, 2010.

Additional:
1. Kościelny J. M., Systemy nadzorowania i wizualizacji procesów przemysłowych ? wymagania, kryteria oceny, PW, Warszawa, 1998.
2. Kasprzyk J., Programowanie sterowników przemysłowych., WNT, Warszawa, 2006.
3. Schneider Electric, Vijeo Citect 7.1, 7.2 - Pierwsze kroki, Instytut Szkoleniowy Schneider Electric, Warszawa.
4. Broel-Plater B., Układy wykorzystujące sterowniki PLC. Projektowanie algorytmów sterowania, Wydawnictwo Naukowe PWN SA, Warszawa, 2008.
5. Kwaśniewski J., Sterowniki PLC w praktyce inżynierskiej, Wydawnictwo BTC, Legionowo, 2008.
6. Kamiński K., Programowanie układów sterowania z PLC, Wydawnictwo Krzysztof Kamiński, Gdynia 2009.
7. Nowak R., Pietrasz A., Trzmiel G., The control and visualisation system in an intelligent building, ITM Web Conf., vol. 19 (01041), 2018, https://doi.org/10.1051/itmconf/20181901041.
8. Trzmiel G., Control and visualisation of the selected industrial processes with the application of SCADA system, Monograph Computer Applications in Electrical Engineering, Poznan University of Technology 2015, vol. 13, pp. 161 - 177.
9. Kurz D. Łopatka M., Trzmiel G., The use of the SCADA system in the monitoring and control of the performance of an autonomous hybrid power supply system using renewable energy sources, E3S Web of Conferences, vol. 44, 2018 (00180), https://doi.org/10.1051/e3sconf/20184400180.
10. Głuchy D., Possibilities of use of the SCADA system for control and visualization of the RES operation, Post-conference Monograph „Computer Applications in Electrical Engineering”, vol. 14, 2016, Poznań, Polska, str. 340-351.
11. CiTechnologies: System pomocy środowiska CitectSCADA., 2006-2012.
12. Dobrzycki A., Ambrozik P., Analiza wpływu elektrowni fotowoltaicznej na sieć elektroenergetyczną, Poznan University of Technology Academic Journals. Electrical Engineering - 2017, Issue 89, s. 321-333.
13. Dobrzycki A., Wodnicki G., Analiza techniczno-ekonomiczna budowy morskiej farmy wiatrowej w warunkach Polski, Poznan University of Technology Academic Journals. Electrical Engineering - 2018, Issue 94, s. 73-86.

14. Internet: specialist subject literature, datasheets, standards.

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