COURSE DESCRIPTION CARD - SYLLABUS

Course name
Electricity demand side management [N1Energ2>SPnE]

Course

Field of study
Power Engineering

Year/Semester
4/8

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
0

Number of credit points

4,00

Coordinators

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Lecturers

Prerequisites

Basic knowledge in mathematics, physics, electrical circuits, electrical power engineering and electricity transmission and distribution. Ability to self-study effectively topics related to the chosen field of study and combine knowledge acquired in previous courses. Ability to assess costs and benefits of implementation of the analyzed processes by its participants. Awareness of the need to extend competences, readiness to cooperate within a team, aiming for efficiency improvements in processes' performance.

Course objective

Gaining knowledge in the field of demand side reponse and energy management, as elements of the sustainable development of energy systems and shaping proper market relations. Understanding the tools for effective shaping of the demand curve and the impact of price elasticity of demand on shaping the load curve in power grids and electricity prices. Getting to know methods of forecasting electricity demand for various customers, basics of designing effective demand control programs, and modern techniques for managing energy flows in power networks.

Course-related learning outcomes

Knowledge:

1. Student is able to characterize new development directions in the area of effective and safe energy management in distribution networks and shaping market relations in this area.
2. Student has knowledge of the basic methods of demand side response and energy management, as well as the principles of designing activities and the use of tools aimed at using the elasticity of electricity demand to optimize its supply to customers.

Skills:
1. Student is able to plan the operation of the power network taking into account the response of the demand side due to the use of smart meters, energy storage devices and demand control programs.
2. Student is able to propose actions aimed at changing the way energy is used to achieve technical and economic benefits, and compare and evaluate proposed solutions in terms of their economic and environmental efficiency.

Social competences:
1. Student is aware of the need to search for new solutions in the field of energy management and electricity supply to the customers, taking into account economic and ecological aspects.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Lecture:
- knowledge and skills assessment through a problem-based written exam, 50 point exam, >50% pass, grades: >95% 5.0, >85%-95% 4.5, >75%-85% 4.0, >65%-75% 3.5, >50%-65% 3.0,
- continuous assessment of student's skills and competences during each class (rewarding attendance and active participation in the classes with additional points included in the exam grade).
Laboratory classes:
- assessment of the knowledge necessary to solve problems in a given task area through written tests,
- continuous assessment during each class - rewarding the increase in the ability to use presented principles and methods,
- assessment of the knowledge and skills concerning the laboratory tasks, evaluation of the laboratory reports and tasks solved as part of self-study,
- point assessment of the particular elements of the classes with the maximum of 100 points, >50% pass, grades: >95% 5.0, >85%-95% 4.5, >75%-85% 4.0, >65%-75% 3.5, >50%-65% 3.0.

Programme content

The electricity market, with a particular focus on the demand-side potential in the national electricity system and the role of demand response in managing energy flow and improving network efficiency. Demand response programs, energy consumption forecasting methods, and the integration of demand response in smart grids, including the use of smart meters and energy tariffs.

Course topics

Lecture:
Supply and demand in the electricity market. Potential of demand side response in the national power system, significance for the operation of the electricity market in Poland and in Europe. Demand side management as an element for managing energy flows in the network and improving the efficiency of energy and network assets use. Types of demand side management programs and related benefits. Construction of demand side response programs. Market analysis for the design of demand management programs. Tariffs as a tool for demand side management. Possibilities of implementing demand response as a result of smart meters' implementation. Demand response as smart grid's element, inducing the improvement of energy security and reliability and quality of electricity supply. Technological solutions enabling effective control of receiving devices. Demand control using distributed and centralized energy storage. Basic design parameters of effective demand response programs. Energy efficiency as a strategic demand management tool. Demand response as an element of the capacity market in the reformed electricity market. Demand management for the purposes of network operators. Methods for forecasting energy consumption for urban, residential or industrial consumers. Influence of the load change due to to demand response on the operation of the power network.
Project:
Demand side management as an element of managing energy flows in the network and improving the

efficiency of energy and network assets use. Influence of the load change due to to demand response on the operation of the power network. Types of demand management programs and related benefits. Construction of demand side response programs. Market analysis for the design of demand management programs. Tariffs as a tool for demand side management. Basic design parameters of effective demand response programs. Methods for forecasting energy consumption for urban, residential or industrial consumers.

Teaching methods

Lecture: multimedia presentation - informational and problem lectures
Laboratory classes: tasks performed in small groups on topics covered during lectures, computer classes using spreadsheets and software enabling analysis of the operation of the power grid

Bibliography

Basic:
1. Billewicz K., Smart metering: inteligentny system pomiarowy, Wydawnictwo Naukowe PWN, Warszawa 2012
2. Górzyński J., Efektywność energetyczna w działalności gospodarczej, Wydawnictwo Naukowe PWN, Warszawa 2017
3. Majka K., Systemy rozliczeń i taryfy w elektroenergetyce, Politechnika Lubelska Wydawnictwo Uczelniane 2005
4. Marzecki J., Rozdzielcze sieci elektroenergetyczne, Wydawnictwo Naukowe PWN, Warszawa 2001
5. Paska J., Ekonomika w elektroenergetyce, Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2007
6. Rasolomampionona D.D., Robak S., Chmurski P., Tomasik G., Przegląd istniejących mechanizmów DSR stosowanych na rynkach energii elektrycznej, Rynek Energii nr 4/2010

Additional:
1. Andruszkiewicz J., Lorenc J., Warunki wdrożenia w Polsce cenowych programów sterowania popytem dla ograniczenia szczytowego zapotrzebowania na energię elektryczną, Przegląd Elektrotechniczny, r. 90 nr 8/2014, 97-10
2. Andruszkiewicz J., Lorenc J., Weychan A., Sterowanie popytem przy wykorzystaniu systemów taryfowych w Polsce, Przegląd Elektrotechniczny, r. 95 nr 10/2019, 48-51
3. Andruszkiewicz J., Lorenc J., Weychan A., Price-based demand side response programs and their effectiveness on the example of TOU electricity tariff for residential consumers, Energies, 2021, 14/2
4. Du P., Lu N., Zhong H., Demand Response in Smart Grids. Springer 2019
5. Kirschen D.S., Strbac G., Fundamentals of Power System Economics, John Wiley & Sons Ltd 2004
6. National Action Plan on Demand Response. The Federal Energy Regulatory Commission Staff USA 2010, Docket No. AD09-10, www.ferc.gov
7. Nojovan S., Zare K., Demand Response Application in Smart Grids, Springer 2020

Breakdown of average student's workload

	Hours	ECTS
Total workload	102	4,00
Classes requiring direct contact with the teacher	32	1,50
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	70	2,50