COURSE DESCRIPTION CARD - SYLLABUS

Course name
Nuclear power plant in the power system [N1Energ2>EJwSE]

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
0

Other
0

Tutorials
10

Projects/seminars
0

Number of credit points

3,00

Coordinators

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Lecturers

Prerequisites

The student has structured knowledge in the field of power engineering, operation of power plants and knows the principles of the power system. Has the ability to solve differential equations, knows the integral calculus and has knowledge of thermodynamics, fluid mechanics and nuclear physics. Is aware of the need to expand competences, readiness to cooperate within a team.

Course objective

Understanding the basic types of nuclear reactors. Familiarization with their construction, concept and thermal systems. Addressing issues related to the security of nuclear power plants. Understanding development trends in nuclear energy.

Course-related learning outcomes

Knowledge:
1. Understands the essence of phenomena occurring in nuclear reactors and the technological process implemented in nuclear power plants, understands the impact of energy transformation processes occurring in nuclear power plants on the natural environment.
2. Knows and understands the principle of cooperation between nuclear power units and the power

system.
3. Understands civilization dilemmas and knows the basic economic, legal and environmental conditions related to the development of nuclear energy. Knows the construction of a nuclear reactor and is able to perform basic calculations of criticality conditions for an energy reactor.

Skills:
1. Student is able to perform basic calculations of the criticality conditions of a nuclear power reactor and calculate the mass flow of the coolant necessary to receive heat generated in the core. Knows approximate methods for solving neutron balance equations.
2. Based on the parameters of the nuclear reactor, the student is able to design a thernak cycle of the power plant.
3. The student is able to analyze the principle of operation of active and passive safety systems in nuclear power plants and assess the effects of possible failures of a nuclear power plant on the environment.
4. Can determine the legitimacy of the application of a given nuclear technology used in a particular branch of the economy.

Social competences:
1. Is aware of the great responsibility of a power engineering engineer at a nuclear power plant for making decisions. Understands the need for continuous training and raising competences in the field of nuclear energy. The student is ready to critically assess his knowledge and to provide the public with reliable information and opinions on nuclear energy, presenting different points of view.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Lecture:
Assessment of knowledge and skills demonstrated in the written test. The minimum passing threshold is 50%,
Laboratory:
- assessment of knowledge and skills related to the implementation of the exercise task, assessment of the report on the exercise performed,

Programme content

Operating conditions of nuclear power plants with the power system.
Operational conditions of a nuclear power plant unit with a pressurized reactor.

Course topics

Lecture:
Energy characteristics of nuclear power plant equipment. Problems of cooperation between nuclear power plants and the power system. Flexibility of operation of power units of nuclear power plants. Conditions for the location of nuclear power plants. Start-up and shutdown of a nuclear power plant unit. Operation of a nuclear power plant. Auxiliary Power Supply System. Main Equipment of Auxiliary Power Supply System. NPP power distribution scheme. Auxiliary power supply system. Emergency power supply system. Severe incidents in NPP's power supply system - LOOP (loss of offsite power) and SBO (station blackout). Algorithms, limits and conditions of safe operation for emergency power supply system.

Laboratory:
1. Introduction
2. Power operation of a nuclear power plant
3. Nuclear power plant shutdown
4. Start-up of the nuclear power plant from the cold state
5. Start-up and synchronization of a nuclear power plant
6. NPP operation failures

Teaching methods

Lecture:

Lecture with multimedia presentation with additional examples given on the board.
Laboratory:
Simulator of the C-PWR 1350 MW nuclear power plant unit.

Bibliography

Basic:
1. Ackermann G., Eksploatacja elektrowni jądrowych, WNT, Warszawa 1987
2. Gałdyś H., Matla R., Praca elektrowni w systemie elektroenergetycznym, WNT, Warszwa 1990
3. Kubowski J., Nowoczesne elektrownie jądrowe, WNT, Warszawa 2010
4. Kubowski J., Elektrownie jądrowe, WNT, 2014

Additional:
1. Tucker C., jak zostać operatorem reaktora jądrowego_ Bielsko-Biała 2022
2. Jezierski G., Energia jądrowa wczoraj i dziś, WNT, Warszawa 2005
3. Sokólski P., Rutkowski T., Ceran B., Horla D., Złotecka D., Power System Stabilizer as a Part of a Generator MPC Adaptive Predictive Control System, Energies - 2021, vol. 14, no. 20, s. 6631-1-6631-25
4. Grządzielski I., Sroka K., Elektrownie jądrowe w warunkach awarii katastrofalnej, Acta Energetica 2011, tom 1, s. 5-10
5. Sokólski, P., Rutkowski, T. A., Ceran, B., Złotecka, D., Horla, D. (2022). The Influence of Cooperation on the Operation of an MPC Controller Pair in a Nuclear Power Plant Turbine Generator Set. Energies, 15, 6702.

Breakdown of average student's workload

	Hours	ECTS
Total workload	85	3,00
Classes requiring direct contact with the teacher	30	1,00
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	55	2,00