COURSE DESCRIPTION CARD - SYLLABUS

Course name
Systems of nuclear power plant [S2EJ1>UTEJ]

Course

Field of study
Nuclear Power Engineering

Year/Semester
1/2

Area of study (specialization)
–

Profile of study
general academic

Level of study
second-cycle

Course offered in
polish

Form of study
full-time

Requirements
compulsory

Number of hours

Lecture
0

Laboratory classes
15

Other (e.g. online)
0

Tutorials
15

Projects/seminars
15

Number of credit points

4,00

Coordinators

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Lecturers

Prerequisites

Ability to solve algebraic equations and systems of equations. Basic knowledge of thermodynamics. Knowledge of concepts: temperature, pressure, enthalpy, entropy, flow. Ability to analyze thermal cycles. Knowledge of the structure and principles of operation of energy devices - pumps, steam turbines, etc. Basic knowledge of heat transfer.

Course objective

Mastering basic knowledge and skills in modeling and conducting energy analyzes of technological systems of nuclear power plants.

Course-related learning outcomes

Knowledge:
1. Student knows the structure and understands the operation of the technological system of a nuclear power plant.
2. Student has knowledge of conducting energy analyzes of technological systems of nuclear power plants.
3. Student has knowledge of the methodology for calculating the efficiency of the thermal cycle

implemented in a nuclear power plant.
4. Student knows and understands the influence of the values of the working medium parameters on the efficiency of the thermal cycle in a nuclear power plant.

Skills:
1. Student is able to analyze the thermal cycle carried out in dry saturated steam using T-s, i-s diagrams.
2. Student is able to determine the enthalpy values of the working medium at individual points in the technological system of a nuclear power plant
3. Student is able to derive, based on the diagram of the thermal system, the balance equations of individual elements of the technological system of a nuclear power plant.
4. Student is able to conduct an energy analysis of the technological system, taking into account the recipient's heat demand.
5. Student is able to model the technological system of a nuclear power plant using engineering software.

Social competences:
1. Student understands the need for teamwork in solving theoretical and practical problems of nuclear energy.
2. Student understands the need to systematically deepen and expand his knowledge and skills.
3. Student is aware of the need for dialogue with people and organizations skeptical about nuclear energy.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Lectures
Written exam on the date given at the beginning of the semester. The list of questions is made available to students at the beginning of the semester. In doubtful cases, the exam is extended with an oral part. Students' activity is assessed during each lecture.
Tutorials
Continuous assessment in each class (rewarding activity). Written final test at the end of the semester. The task involves carrying out an energy analysis of the technological system of a nuclear power plant. The condition for passing the exam and obtaining a pass in the auditorium exercises is to obtain at least 50% of the maximum number of points.
Laboratory classes
Continuous assessment in each class (rewarding activity). Completing classes by completing a report.
Project
Assessment of knowledge and skills related to the implementation of a design task, assessment of the completed project.

Programme content

Lectures
Thermal systems of nuclear power plants with various types of rectors. Thermal systems of nuclear power plants with PWR pressurized reactors. Implementation of the Rankine thermal cycle using saturated dry steam. Steam cycle of a nuclear power plant with moisture separation and interstage steam superheating. Regenerative feed water heating. Technological systems of nuclear power plants with boiling water reactors BWR. Steam cycles of a nuclear power plant with a BWR reactor. Technological systems of nuclear power plants with channel reactors. Technological system of a nuclear power plant with an RBMK reactor. Technological system of a nuclear power plant with a CANDU reactor. Technological systems of nuclear power plants with high-temperature gas reactors. Heating of nuclear power plant blocks.
Tutorials
Energy calculations of technological systems of nuclear power plants. Determination of the steam enthalpy value at individual points of the technological system. Formulating, based on the thermal diagram, balance equations of individual elements of the system. Balance equations of a turbine set, exchangers for regenerative heating of feed water, and a deaerator. Determination of working medium flows in the secondary circuits of a nuclear power plant with a pressurized reactor. Determining the value of the theoretical efficiency of the secondary circuit.
Laboratory classes

Modeling of technological systems of nuclear power plants using EBSILON Professional software. Getting to know the EBSILON Professional environment. Modeling of technological systems of nuclear power plants with pressurized reactors. Modeling of technological systems of nuclear power plants with boiling water reactors. Extension of the nuclear power plant system to a nuclear power plant.
Project
Designing the technological system of a nuclear power plant intended to cover the demand for electricity and heat.

Teaching methods

Lecture delivered remotely using synchronous access methods.
Lectures:
Multimedia presentation.
Tutorials:
Calculation problems solved on the board, determining the value of steam enthalpy using the i-s diagram or thermodynamic tables.
Laboratory classes:
Conducted at computer workstations using EBSILON Professional software.
Project:
Independent solution of a design problem.

Bibliography

Basic:
1. Pawlik M., Strzelczyk F., Elektrownie WNT 2023
2. Marecki J., Podstawy przemian energetycznych, WNT-2014
3. Kubowski J. Elektrownie Jądrowe WNT2013
4. Portacha J. Układy cieplne elektrowni i elektrociepłowni konwencjonalnych, jądrowych i odnawialnych. Oficyna Wydawnciza Politechniki Warszawskiej, Warszawa-2016
5. Chmielniak T. Technologie energetyczne, PWN Warszawa 2021

Additional:
1. Andrzejewski S. Podstawy projektowania siłowni cieplnych WNT-1974
2. Jezierski G. Energia jądrowa wczoraj i dziś, WNT 2005
3. Dobrzyński L. (red.) Zarys nukleoiniki, PWN, 2017
4. Radosław Szczerbowski, redakcja naukowa. Energetyka węglowa i jądrowa: wybrane aspekty, Poznań 2017
5. Radosław Szczerbowski, Modelowanie układów technologicznych elektrowni jądrowych, Poznań University of technology Academic Journals, Electrical Engineering 2012

Breakdown of average student's workload

	Hours	ECTS
Total workload	107	4,00
Classes requiring direct contact with the teacher	62	2,50
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	45	1,50