COURSE DESCRIPTION CARD - SYLLABUS

Course name
Technological thermo-fluid systems of nuclear power plants [S2EJ1>SCPwEJ]

Course

Field of study
Nuclear Power Engineering

Year/Semester
2/3

Area of study (specialization)
–

Profile of study
general academic

Level of study
second-cycle

Course offered in
Polish

Form of study
full-time

Requirements
elective

Number of hours

Lecture
30

Laboratory classes
0

Other
0

Tutorials
15

Projects/seminars
0

Number of credit points

3,00

Coordinators

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Lecturers

Prerequisites

The student should have a well-structured basic theoretical and practical knowledge i fields of thermodynamics, fluid mechanics, elements of heat transfer and gas dynamics, necessary for modeling thermodynamic and flow phenomena. He should be aware of the construction of basic power machinery and equipment, as well as methods for evaluating their efficiency. Skills: The student should have the ability to obtain the required thermodynamic-fluid parameters, along with the ability to apply them, in theoretical equations describing the operation of thermo-fluid technological systems of nuclear power plants. Social competencies: The student is aware of the importance and understands the non-technical aspects and consequences of the activities of a power engineer, including its impact on the environment and the associated responsibility for decision-making.

Course objective

To familiarize students with advanced theoretical knowledge and practical skills in the operation of thermo-fluid systems in nuclear power plants.

Course-related learning outcomes

Knowledge:

1. The student has knowledge of the relation of basic physical parameters and the efficiency of power machines, as well as their impact on the operation of the overall system.
2. The student has basic legal knowledge related to the operation and design of energy systems including energy equipment used in industry.
3. The student has a basic knowledge of the life cycle of equipment, technical facilities and systems used in the power industry, especially in the nuclear power sector.
4. The student knows the fundamentals describing the operation of steam turbines beyond nominal parameters.

Skills:
1. The student can determine the required parameters of heat exchangers.
2. The student can determine the operating parameters of a steam turbine.
3. The student can select the control system of pump circulating fluid systems.
4. The student is able to determine the energy losses in the nuclear power plant circuit.
5. The student is able to select an emergency power system.

Social competences:
1. Is able to think and act effectively in the area of implementation of energy conversion processes in thermal-fluid systems.
2. He is ready to fulfill social obligations ad coordinate activities for the benefit of the social environment.
3. The student is ready to work and think in an entrepreneurial way.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Lectures
The knowledge acquired in the lecture is verified in a written exam consisting of 10 open questions scored from 0 to 2 points. Passing level: >50% of the points
Tutorials
Continuous assessment in each class of skills and competencies through solving scientific tasks and analysis of special cases. Evaluation of the student's knowledge and skills on the basis of a final written test consisting of solving 5 tasks. Passing level: >50% of the points.

Programme content

Lectures
Types and operating parameters of steam turbines. Effect of fresh steam parameters on the operation of turbines operating in nuclear circuits. The issue of moisture separation, the selection of turbine splitting pressure. Problems of turbine operation beyond rated parameters. Mechanisms of heat transfer. Design of heat exchangers used in nuclear circuits. Temperature efficiency of heat exchange systems. Design and operation of steam generators and condensers applicable to the nuclear power sector. Methods of operating and combining steam generators. Types of design of circulating and feed pumps, pump operating characteristics, selection and regulation of pumps, and ways of their operation and operation in circuits found in nuclear power plants. The operating principle, construction and operation of components of high-pressure systems including barrage fittings, pressure regulators, bleed and safety valves.
Tutorials
Solving practical problems of thermal-fluid systems occurring in nuclear power plants. Application of the 1st and 2nd laws of thermodynamics, selected issues of heat transfer and fluid mechanics. Calculation of thermal cycles occurring in nuclear power plants.

Course topics

Topics in line with curriculum content

Teaching methods

Lectures: multimedia presentation (including drawings, photos, animations) supplemented with explanations provided on the blackboard.
Tutorials: solving sample scientific and engineering problems related to the operation of equipment and machinery used in power plants.

Bibliography

Basic:
1. Chmielniak T.: Technologie energetyczne, WNT, Warszawa 2008
2. Celiński Z., Strupczewski A.: Podstawy energetyki jądrowej, WNT, Warszawa 1984
3. Hobler T.: Ruch ciepła i wymienniki, WNT 1979
4. Wiśniewski St., Wiśniewski T.: Wymiana ciepła, WNT 1997
5. Jędral W., Pompy wirowe, WNT, Warszawa 2001
6. Perycz S., Turbiny parowe i gazowe; Wydawnictwo PG, Wydawnictwo IMP PAN 1992

Additional:
1. Jezierski G., Energia jądrowa wczoraj i dziś, WNT, Warszawa 2005
2. Szargut J., Ziębik A.: Podstawy energetyki cieplnej, PWN, Warszawa 1998
3. Ackermann G., Eksploatacja elektrowni jądrowych, WNT, Warszawa 1987
4. Walczak J., Inżynierska Mechanika Płynów, Wydawnictwo PP, 2006
5. Pudlik W.: Wymiana i wymienniki ciepła, WPG, Gdańsk 1983
6. M. Joachimiak, D. Joachimiak, and P. Krzyslak, “Analysis of heat flow in a tube bank of a condenser considering the influence of air,” Archives of Thermodynamics, vol. 38, no. 3, 2017, doi: 10.1515/aoter-2017-0019.

Breakdown of average student's workload

	Hours	ECTS
Total workload	77	3,00
Classes requiring direct contact with the teacher	47	2,00
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	30	1,00