COURSE DESCRIPTION CARD - SYLLABUS

Course name
Conventional Energy [S2EPiO1-ECiO>EK]

Course

Field of study
Industrial and Renewable Energy Systems

Year/Semester
1/2

Area of study (specialization)
Thermal and Renewable Energy

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
30

Laboratory classes
15

Other
0

Tutorials
0

Projects/seminars
0

Number of credit points

3,00

Coordinators

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Lecturers

Prerequisites

Student should have basic knowledge in mathematics (integration, differentiation) and in physics, also in thermodynamics (first course). Should be able to obtain information from the library and internet, should be ready to cooperate in a team.

Course objective

The aim of the course is to acquaint the student with the technological processes occurring in the conventional power plants, and in the combined heat and power plants, as well as with the most modern energy-saving technologies. The acquired knowledge can be useful during modernization of the existing power plants or designing new facilities.

Course-related learning outcomes

Knowledge:
1.student has knowledge of equipment used in the conventional power plants, knows the basic principles occurring in the life cycle of machines.
2.student has knowledge of the operational parameters impact on the efficiency of energy machines and on the whole energy system.

3.student has knowledge of the negative influence of the conventional power plants on the natural environment.

Skills:
1.student is able to use the numerical methods and the experimental results to solve the engineering thermodynamic problem.
2.student is able to use the engineering norms, knows how to use the professional experience of engineers working in power plant to solve the thermodynamic problem.
3.student is able to lead the engineering team working in the field of the conventional power plant.

Social competences:
1.student is able to critically assess the received information in the field of conventional power plants.
2.student is prepared to operate effectively in the field of conventional power plants.
3.student knows his/her role in society and is ready to work effectively in the field of conventional power plant to fulfill expectations.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

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Lecture - written exam. Obtaining credit from a minimum of 51% of the points possible to get. There is a possibility of an oral question to raise the grade. Laboratory classes: tests and raports.

Programme content

General characteristics of energy conversion processes. Thermodynamics of humid air. Thermodynamics of combustion processes. Maxwell thermodynamic equations. The thermodynamics of wet steam. Supercritical fluids. Rankine cycle and methods of its optimization. Elements of the fuel supply system (steam turbines, boilers, condensers, cooling systems). Heat exchangers. Modeling of conventional power plant systems. Impact of energy technologies on the natural environment. Energy audit. The energy balance of supercritical cycle. Determination of the energy balances and efficiency of thermal devices (based on measurement data from selected power plants).

Course topics

Energy and its types. Transformation of the Polish Energy Sector. The general characteristics of energy conversion processes. The right-handed and left-handed circles. The gas circles (engines) and their efficiency. The isentropic and polytropic processes. Cycles with regeneration. The water vapor and its properties: phase changes, degree of dryness, heat of vaporization, (s,h) and (s,T) diagrams. Thermodynamic processes of wet and superheated steam: isobar, isotherm, isochore and isentrope. Methods of increasing the efficiency of the cycles (traditional: secondary superheating, heating of feed water). Calculation examples. The critical point and properties of supercritical fluids. The supercritical cycles - examples. Compressibility factor. Numerical methods in the process of power plant optimization - examples. Thermodynamics of the combustion processes (the balance of: carbon, hydrogen, nitrogen, oxygen). Examples. Elements of the fuel supply system and heating system devices (boilers, steam turbines, pumps, exchangers for regenerative feed water heating, condenser). The thermodynamics of humid air, absolute humidity, relative humidity, moisture content, dew point. The cooling systems in the conventional power plants. The energy balance of cooling systems. The combined steam and gas cycles - carnotization. Ecological aspects (EU directives). Carbon dioxide sequestration.

Teaching methods

Lecture: multimedia presentation illustrated with examples on the board. In laboratory classes the measurements are performed using equipment existing in ITE.

Bibliography

Basic
1.Chmielniak, T., Technologie energetyczne, WNT, 2008
2.Szargut, J. Termodynamika, PWN, Warszawa, 2000
3.Gąsiorowski, J. Radwański, E., Zagórski, J., Zgorzelski, M., Zbiór zadań z teorii maszyn cieplnych, WNT

Warszawa (wszystkie wydania)
4.Furmański, P., Domański, R., Wymiana ciepła, Przykłady obliczeń i zadania, Oficyna Wydawnicza Politechniki Warszawskiej, 2002
Additional
1.Cengel, Y., Boles, M.A., Thermodynamics, an engineering approach, Mc Graw Hill, 2008.
2. Incropera, F., DeWitt, D., Fundamentals of heat and mass transfer, Wiley, 2008 3. Ghiaasiaan, M., Convective heat and mass transfer, Cambridge University Press, 2014
3. Ghiaasiaan, M., Convective heat and mass transfer, Cambridge University Press, 2014

Breakdown of average student's workload

	Hours	ECTS
Total workload	90	3,00
Classes requiring direct contact with the teacher	50	2,00
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	40	2,00