COURSE DESCRIPTION CARD - SYLLABUS

Course name
Combined heat and power [S1Energ2>SWEEiC]

Course

Field of study
Power Engineering

Year/Semester
3/5

Area of study (specialization)
–

Profile of study
general academic

Level of study
first-cycle

Course offered in
Polish

Form of study
full-time

Requirements
compulsory

Number of hours

Lecture
30

Laboratory classes
0

Other
0

Tutorials
15

Projects/seminars
0

Number of credit points

4,00

Coordinators

dr inż. Daria Złotecka
daria.zlotecka@put.poznan.pl

Lecturers

Prerequisites

1. Student has basic knowledge of thermodynamics, fluid mechanics, technologies and energy machines, fuels and their use. 2.Solving the problems of mass and energy balance in simple thermal cycles of a power plant. 3. Student is aware of the need to expand their competences, is ready to cooperate as part of the team.

Course objective

Acquiring the ability to carry out energy and economic analysis of complex technological systems of combined heat and electricity generation with the use of various types of primary energy.

Course-related learning outcomes

Knowledge:
1. Student has an ordered and theoretically founded knowledge of the basics of combined heat and electricity production.
2. Student knows and understands the phenomena, processes and technological systems that allow the conversion of energy from renewable sources into electricity and heat.

Skills:
1.Student can recognize and explain diagrams for various cogeneration technologies.
2. Student can evaluate the technologies of combined electricity and heat production in terms of their efficiency and environmental impact.
3. Student can identify and justify prospective cogeneration technologies..

Social competences:
1. Students aware of the social effects of rational use of energy resources in order to meet the energy needs of the country.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Lecture:
Written exam. The exam consists of 5 questions, scored with 5 points each. The examination has a pass rate of 51%.
Tutorials:
Written final test (calculation task) and continuous evaluation of student progress on each tutorials. The calculation task has a pass rate of 51%.

Programme content

The module programme includes:
- cogeneration technologies,
- thermal systems and operating parameters of combined heat and power plants (CHPs),
- micro-cogeneration technologies,
- basics of technical and economic analysis of the operation of CHPs.

Course topics

The lecture programme includes:
- backpressure and extraction-condensing turbines in combined heat and power plants (CHPs),
- gas CHPs and Combined Cycle CHPs,
- distributed cogeneration with the use of microturbines and reciprocating engines,
- fuel cells cogeneration systems,
- ORC systems,
- cooperation of a combined heat and power plant with a heating network,
- basics of energy planning in the field of electricity and heat supply,
- technical and economic rationale for the choice of a technological solution for a CHP,
- energy analysis of CHP operation and costs of combined heat and electricity production,
- support mechanisms for CHPs.

The tutorials programme includes:
- energy analysis of the technological system of CHPs.

Teaching methods

Lecture
Lecture with multimedia presentation supplemented with examples given on the board.
Tutorials
Tasks counted on the board.

Bibliography

Basic:
1. J.Szargut, A.Ziębik, Podstawy energetyki cieplnej, PWN, 2000
2. J. Skorek, J. Kalina, Gazowe układy kogeneracyjne, WNT, Warszawa 2005
3. J. Marecki, Gospodarka skojarzona cieplno-elektryczna, WNT, W-wa 1991

Additional:
1. R. Bartnik, Elektrownie i elektrociepłownie gazowo-parowe, WNT 2012, 2017

2. K.Buczek, Skojarzone wytwarzanie ciepła i energii elektrycznej w małych elektrociepłowniach, Wydawnictwo i Handel Książkami; Krosno.2001
3. B, Kolanowski, Small Scale Cogeneration Handbook, Fairmont Press, 2011
4. M.Pawlik, F.Strzelczyk, Elektrownie, WNT W-wa 2012, 2017
5. R. Turschmid, Kotłownie i elektrociepłownie przemysłowe, Arkady, W-wa 1988
6. K. Badyda, A. Miller, Energetyczne turbiny gazowe oraz układy z ich wykorzystaniem, Kaprint, Lublin 2011
7. D. Złotecka, A. Maćkowiak, K. Sroka, Impact of Escalating Emission Requirements on the Operation of Heating Systems in Poland, 15th International Conference on the European Energy Market (EEM): IEEE, 2018, s. 1-5

Breakdown of average student's workload

	Hours	ECTS
Total workload	107	4,00
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)	60	2,00