COURSE DESCRIPTION CARD - SYLLABUS

Course name
District Heating [N1IŚrod2>Ciepł]

Course

Field of study
Environmental Engineering

Year/Semester
4/7

Area of study (specialization)
–

Profile of study
general academic

Level of study
first-cycle

Course offered in
Polish

Form of study
part-time

Requirements
compulsory

Number of hours

Lecture
20

Laboratory classes
0

Other
0

Tutorials
10

Projects/seminars
0

Number of credit points

4,00

Coordinators

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Lecturers

Prerequisites

Fundamentals of heating. Fundamentals of combustion processes. Flow of incompressible fluid in pipes, pressure losses, selection of pumps. Pressure, units of pressure. Basics of heat transfer. Fundamentals of materials science. Calculation of simple and complex hydraulic systems. Calculation of heat flux through flat and curved partitions. Balancing heat demand for the selection of radiators, calculating the heat transfer coefficient of a partition. Ability to work in a team. Awareness of the need for continuous updating of knowledge and skills.

Course objective

Discussion of issues related to the generation, transmission and use of heat, building on knowledge of heating. Learning the structures, principles of operation and design of remote district heating systems including: heat source, thermal network and thermal nodes, with particular emphasis on high- parameter systems. Presentation of practical implementations of hydraulic schemes on the example of real objects. Demonstration of the operation of heating and district heating systems in the annual operating cycle beyond the nominal operating point. Paying attention to automation and control of thermal performance at partial load. Discussion of the impact of the selection of the amount and size of the heat source and the system operating parameters (temperature and pressure) on its energy efficiency and failure rate. Presentation of pressure distribution in a district heating system and discussion of its importance for the correctness and safety of its operation. Presentation of prospects for the development of district heating systems.

Course-related learning outcomes

Knowledge:
1. The student has knowledge of the systems and development trends in urban and industrial heat supply systems based on conventional heat sources.
2. Has knowledge of the principles of construction, design and operation of: medium-power district heating plants, heat networks and heat substations.
3. Has knowledge of the algorithm of design of district heating system and social, economic and other non-technical conditions of engineering activity.

Skills:
1. Student is able to calculate the thermal power of sources supplying heat to buildings
2. Can designs medium power district heating plants and heat networks with control and protection systems
3. Can make a structured diagram of heat needs and analyze the operation of the district heating system during the year
4. Is able to draw a pressure line for a high-parameter district heating system.

Social competences:
1. The student is aware of the role of the district heating system in the urban agglomeration.
2. Understands the need and desirability of teamwork in solving theoretical and practical issues.
3. Understands the social and political factors affecting district heating systems.
4. Sees the need to systematically deepen and expand his/her competence.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Lectures:
Exam in the form of questions (and/or): open, calculation, drawing, test of various types.
Grading scale: 0-50%: 2,0; 51-60%: 3,0; 61-70%: 3,5; 71-80%: 4,0; 81-90%: 4,5; 91-100%: 5,0.

Tutorials:
Written credit or defense/presentation of term assignment

Project:
Ongoing control of project implementation during exercises and consultations; project credit based on an oral and/or written defense of the completed work.

Programme content

The module program includes:
1. Introduction to issues related to district heating.
2. Heat balancing for heating purposes.
3. Heat sources, heat networks, heat nodes.
4. Operating parameters of heating systems.
5. Basic technical problems and challenges related to district heating.

Course topics

Lectures:
1. Review of basic issues in the field of district heating: historical outline, classical division and structure of district heating systems. Technical aspects and characteristics of heat generation, transmission and utilization.
2. Heat balance of the district heating system (central heating, ventilation, hot water, losses, technological needs and others). Analysis of annual variation of heat demand.
3. Technological diagrams of high-parameter district heating plants. Case studies.
4. Control and protection systems.
5. Heat networks - materials used, routing of pipes, selection.
6. Thermal nodes - introduction, review of structures.
7. Pressure distribution in a district heating system.
8. Review of systems for treatment, degassing and replenishment of water in the deposit and pressure stabilization.
9. Algorithm of design of district heating systems (typical operating parameters and their impact on the district heating system).
10. Current trends and prospects for the development of district heating systems.

Tutorials:
A series of calculation tasks including:
1. Index calculations of heat demand for central heating, ventilation, hot water preparation.
2. Flows in district heating networks, heat losses, compensation of thermal extensions of district heating networks.
3. Balance of flows in complex heating systems: circuits with mixing, hydraulic coupling.
4. Balance of a multifunctional district heating network, principles of selection of fittings and equipment.

Project:
A series of short design issues including heat balance, equipment selection and drawing documentation of a multi-functional heat substation with differential pressure control valve.

Teaching methods

Lectures:
Informative lecture with elements of a conversational lecture; Problem lecture; Multimedia presentation; Discussion; Didactic quiz; Exercise elements; Discussing case studies

Tutorials:
Problem method; Interactive problem solving; Solving tasks; Interactive online materials; Independent work

Project:
Individual or teamwork on projects; Consultations

Bibliography

Basic:
[1] Bagieński Z., Amanowicz Ł., Ciepłownictwo. Projektowanie kotłowni i ciepłowni, Wydawnictwo Politechniki Poznańskiej 2018
[2] Nantka M. B., Ogrzewnictwo i ciepłownictwo, tom I, Wyd. Politechniki Śląskiej, Gliwice 2013
[3] Zaborowska E., Projektowanie kotłowni wodnych na paliwa ciekłe i gazowe, Wyd. Politechniki Gdańskiej 2018
[4] Mizielińska K., Olszak J., Gazowe i olejowe źródła ciepła małej mocy, OWPW, Warszawa 2006
[5] Krygier K., Sieci ciepłownicze, OWPW, Warszawa 2006
[6] Zaborowska E., Zasady projektowania wodnych węzłów ciepłowniczych, Wyd. Politechniki Gdańskiej, 2018

Additional:
[1] Szkarowski A., Łatowski L., Ciepłownictwo, WNT, Warszawa 2006
[2] Żarski K., Obiegi wodne i parowe w kotłowniach, Warszawa 2000
[3] Krygier K., Wybrane zagadnienia z ciepłownictwa, WPW, Warszawa 1989 oraz Sieci cieplne, materiały do ćwiczeń projektowych, WPW, Warszawa 1993

[4] Żarski K., Węzły cieplne w miejskich systemach ciepłowniczych, Wydawnictwo Instal, 2014
[5] Foit H., Indywidualne węzły cieplne, WPŚ, Gliwice 2010

Breakdown of average student's workload

	Hours	ECTS
Total workload	100	4,00
Classes requiring direct contact with the teacher	40	1,50
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	60	2,50