COURSE DESCRIPTION CARD - SYLLABUS

Course name
Air Conditioning and Refrigeration

Course

Field of study
Environmental Engineering
Area of study (specialization)

Level of study
First-cycle studies
Form of study
full-time

Year/Semester
3 / 6
Profile of study
general academic
Course offered in
Polish
Requirements
compulsory

Number of hours

Lecture
45
Laboratory classes

Other (e.g. online)

Tutorials
15
Projects/seminars
30

Number of credit points

6

Lecturers

Responsible for the course/lecturer:
prof. dr hab. inż. Edward Szczechowiak

email: edward.szczechowiak@put.poznan.pl

tel. 61-665-25-33

Faculty of Environmental Engineering and Energy

Berdychowo 4, 61-131 Poznań

Responsible for the course/lecturer:
dr hab. Mieczysław Porowski, prof. PP

email:mieczyslaw.porowski@put.poznan.pl

tel. 61-665-24-14

Faculty of Evironmental Engineering and Energy

ul. Berdychowo 4, 61-131 Poznań

Prerequisites

1. Knowledge:

Knowledge of mathematics, physics, chemistry and biology, which is the basis for understanding the mathematical transformations and the identification and evaluation of thermal and microbiological areas and devices for air preparation.

Knowledge of thermodynamics, heat transfer, fluid mechanics and ventilation - in the field of thermodynamics of moist air, the theory of penetration, conductivity and heat transfer and flow of indoor air and ventilation units.

2. Skills:

The ability to perform mathematical transformations, derivation of mathematical formulas and solving classic linear equations and differential equations.

The ability to perform hydraulic calculations, calculations of heat losses, cooling loads and perform engineering drawings in AutoCAD.

3. Social competencies:

The student should be aware of the consequences of decisions.

The student understands of the need to constantly update and supplement knowledge and skills.

Course objective

The aim is to gain knowledge and skills in the field of air conditioning and the cooling in buildings in the design processes and technology of those systems and conduct analyzes of pre processes and equipment used in air conditioning installation and performance in this area.

Course-related learning outcomes

Knowledge

1. Knows climatic comfort parameters, determining thermal and cooling loads for the selection of air-conditioning devices (lectures, exercises, and design).

2. Knows the processes of thermodynamic air preparation in air conditioning equipment and central units (also on the h-x chart) and the fundamental structures of air conditioning and refrigeration systems for air conditioning used in construction (lectures, exercises and design).

3. Knows the selection of air conditioning AHUs and the characteristics of all components of AHUs, in particular: air filters, heaters, coolers, humidifiers, heat recovery exchangers, fans, refrigerating units, condensers, air conditioners obtained on the lecture and design) .

4. Has general knowledge regarding the development of the concept of the structure of an air conditioning and refrigeration system for a room/building, and knows the fundamental structures of air conditioning control panels and air conditioning systems (obtained during the lecture and project).

5. Understands the basic programs for calculating air conditioning systems (lecture).

Skills

1. Can determine the calculation parameters of thermal comfort and air quality in air-conditioned rooms and calculate heat and cooling loads as well as the amount of supply air (obtained during exercises and design).

2. Can perform calculations in the scope of air distribution in the room to select diffusers and extractors in air conditioning systems (obtained on the project).

3. Can perform calculations of the efficiency and size of components in an air-handling unit, taking into account the effectiveness of heat recovery devices from exhaust air and present the interpretation of calculations on the h-x graph (obtained in the exercises and design).

4. Can choose the air conditioning system for the room (obtained in the lecture and project).

5. Can use the catalogs of device manufacturers and select devices based on charts or selection programs (obtained on the project).

Social competences

1. Is aware of the impact of climate comfort on human well-being (obtained during the lecture).

2. Is aware of the need to systematically deepen and expand their competences (obtained during lectures, exercises, and the project).

3. Is aware of the importance of air conditioning as a technical element of building equipment affecting human health, safety, and productivity (obtained during the lecture and project).

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

> Lecture

Written exam: duration 90 min, checking skills (1 task), checking knowledge (5 questions), the maximum number of points: 40 points (5 points for each item and 15 points for calculating the task), pass mark: 20 points Oral exam: random questions, the possibility of increasing the grade obtained in the written exam.

> Tutorials

Knowledge test at the end of the semester. The threshold to pass 50% of the maximum number of points.

> Design

Individual design; ongoing control of project implementation during the exercises in the form of a written test, 3 tests are provided, for each test a grade of 2.0-5.0, and the pass mark is 50%. You must pass every test with a minimum score of 3.0. The grade for each part of the project is the grade for the

test and the inclusion of classwork and timeliness of donating individual sections of the project. The drawing part and hydraulic calculations will be assessed separately. The project grade is the average of four grades.

Programme content

The history of the development of air-conditioning. Concepts definition of air conditioning (differences in relation to ventilation), classifications. External climate parameters. Parameters of climate comfort, including thermal comfort air quality and adaptive comfort. Loads for ventilation and air conditioning: the gain of sensible heat, cooling load, the profits of moisture emissions. Sizing air ducts, lines of pressure. Elements of central air conditioning systems - and calculations: fans, filters, heaters, coolers, humidifiers and dehumidifiers, recuperators, regenerators, dampers, air intakes, launchers, valves, fire dampers. Structures and systems of air conditioning - divisions. Air conditioning using only the air: Single-channel, dual-channel, zonal, with variable air volume (VAV). Mixed systems: the nozzle fan coil, with chilled ceilings. Local air conditioning systems: air conditioners, compact systems, SPLIT, VRV. Systems of energy-saving air conditioners. Regulation and control in air conditioning and refrigeration systems. Adjusting the temperature and humidity, diagrams of basic regulatory systems. Methods of cooling air. The cooling circuits used in air conditioning systems, refrigerants, refrigeration cycles. The compressor cooling circuits and the absorption cooling circuits. Components and equipment of refrigeration systems. Refrigerants and coolants. Chillers for air conditioning. Heat pumps used in air conditioning.

Design: for the selected open-space room, for which ventilation installation for hygienic purposes is designed, it is necessary to design and select an air treatment scheme to ensure the regulation of air parameters in the room in terms of temperature and relative humidity throughout the year. Detailed tasks: a selection of external, internal and supply air parameters; calculation of cooling loads; selection of a system supporting ventilation in receiving cold loads (cooling ceiling); selection of a certain air-conditioning unit in the selection program; air treatment on the h-x chart for summer and winter; device power calculations; cooling circuit ensuring operation of the air handling unit; drawings - installation diagrams.

Teaching methods

Informative lecture, lecture with multimedia presentation, problem lecture.

Design exercises: presentation of solutions for analytical and design issues, case studies, consultation of individual solutions, discussion.

Bibliography

Basic

1. Recknagel H., Sprenger E., Schramek E.R.: Kompendium wiedzy: ogrzewnictwo, klimatyzacja, ciepła woda, chłodnictwo, Wydawnictwo Omni Scala, Wrocław 2008

2. Pełech A.: Wentylacja i klimatyzacja - podstawy. Oficyna Wydawnicza Politechniki Wrocławskiej. Wrocław 2008.

3. Pełech A., Szczęśniak S.: Wentylacja i klimatyzacja. Zadania z rozwiązaniami i komentarzami. Oficyna Wydawnicza Politechniki Wrocławskiej. Wrocław 2012

4. Lipska B.: Projektowanie wentylacji i klimatyzacji. Podstawy uzdatniania powietrza. Wydawnictwo Politechniki Śląskiej Gliwice 2012

5. Malicki M.: Wentylacja i klimatyzacja. PWN Warszawa 1980

6. Jones W.P.: Klimatyzacja. ARKADY. Warszawa 2001

Additional

1. Gaziński B.: Technika klimatyzacyjna dla praktyków. Komfort cieplny, zasady obliczeń i urządzenia. Systherm Serwis. Poznań 2005

2. Baumgarth, Horner, Reeker: Poradnik Klimatyzacji. Tom 1: Podstawy. Wydanie 1 polskie na podstawie 5. zmienionego i rozszerzonego wydania niemieckiego. Systherm, Poznań 2011

Breakdown of average student's workload

	Hours	ECTS
Total workload	150	6,0
Classes requiring direct contact with the teacher	90	3,5
Student's own work (literature studies, preparation for classes, preparation for tests/exam, project preparation) [1]	60	2,5

[1] delete or add other activities as appropriate