COURSE DESCRIPTION CARD - SYLLABUS

Course name

Ventilation, Air Conditioning and Refrigeration Systems (part one)

Course

Field of study

Environmental Engineering

Area of study (specialization)

Heating, Air conditioning and Air Protection

Level of study

First-cycle studies

Form of study

full-time

Year/Semester

1 /2

Profile of study

general academic

Course offered in

Polish

Requirements

compulsory

Number of hours

Lecture

30

Laboratory classes

Other (e.g. online)

Tutorials

30

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:

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 (after the second semester): 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

Systems design

1. Rules for designing buildings and technical equipment systems.

2. Development of energy-saving and sustainable buildings.

3. A contemporary approach to designing energy-efficient buildings.

4. Evolutions in the design of systems of technical equipment for energy-saving buildings.

5. Principles and process of integrated design.

6. Energy analysis of buildings.

7. Examples of computer programs for HVAC systems simulation.

8. Energy efficiency of buildings - energy performance.

9. Energy requirements for nearly zero-energy buildings.

10. The tightness of buildings and the impact on ventilation.

11. Ventilation systems for energy-efficient buildings, hybrid ventilation.

12. Ventilation strategies and energy-saving control.

13. Solutions for energy-efficient ventilation of residential buildings.

14. Fire ventilation and smoke extraction: high and hall buildings.

15. Fire ventilation: underground garages and communication tunnels.

16. Principles for design and analysis of energy-saving air conditioning systems.

17. Air conditioning of atrial buildings.

18. Air conditioning of office and hotel buildings - energy-saving solutions.

19. Integrated heating and cooling systems in building air conditioning.

20. Air conditioning systems with heat pumps.

21. Principles for energy-efficient cooling of rooms. Night cooling.

22. Optimization of cooling loads on buildings.

23. Integrated heat and cold sources.

24. Ice water generators.

25. Condensers and cooling towers.

26. Cooling systems with cooling tanks.

27. Design principles for refrigeration centers.

28. Examples of HVAC system solutions for sustainable buildings.

29. Air conditioning of swimming pool halls. Swimming pool air-conditioning centers.

30. Control algorithms and economical operation of HVAC systems.

Project 1 topics:

A refrigeration system for supplying air coolers in central units, fan coils or cooling beams, or cooling ceilings with the selection of basic devices and drawings of proposed solutions should be designed for the selected object.

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. Jones W.P.: Klimatyzacja. Arkady Warszawa 1981, 2001.

2. Gaziński B., Szczechowiak E.: Kształtowanie klimatu budynków trzody chlewnej. PWRiL Warszawa, Poznań 1988.

3. Recknagel/Sprengel/Schramek: Ogrzewnictwo, Klimatyzacja, Ciepła woda, Chłodnictwo. Poradnik. Wyd. Omni Scala Wrocław 2008.

4. Porowski M., Szczechowiak E.: Klimatyzacja pomieszczeń czystych. Wyd. TerMedia 1999.

5.Mizieliński B., Kubicki G.: Wentylacja pożarowa. Oddymiania. WNT Warszawa 2012.

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

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

Additional

1. Praca zbiorowa: Handbuch der Klimatechnik. Band 1: Grundlagen 1989, Band 2: Berechnung und Regelung 1989, Band 3: Bauelemente 1988. C.F. Mueller Karlsruhe.

2. Daniels K.: Gebäudetechnik. Oldenbourg Verlag Munchen 1992.. Mizieliński B.: Systemy oddymiania budynków. WNT Warszawa 1999.

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

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

5. Eicher U.: Low Energy Cooling for Sustainable Buildings. Wiley & Sons Inc. 2009

6. Randall T. (ed.): Environmental Design – An Introduction for Architects and Engineers. Spon Press, London 2001.

7. Hawkes D., McDonald J., Steemers K.: The Selective Environment – An Approach to Environmentally Responsive Architecture. Spon Press, London 2002.

8. Daniels K.: Low-Tech, Light-Tech, Hight-Tech – Building in the Information Age. Birkhäuser, Basel 1998.

Breakdown of average student's workload

	Hours	ECTS
Total workload	150	6,0
Classes requiring direct contact with the teacher	90	4,0
Student's own work (literature studies, preparation for classes, preparation for tests/exam, project preparation) [1]	60	2,0

[1] delete or add other activities as appropriate