COURSE DESCRIPTION CARD - SYLLABUS

Course name

Ventilation

Course

Field of study

Environmental Engineering

Area of study (specialization)

Level of study

First-cycle studies

Form of study

full-time

Year/Semester

3 / 5

Profile of study

general academic

Course offered in

Polish

Requirements

compulsory

Number of hours

Lecture

30

Laboratory classes

Other (e.g. online)

Tutorials

15

Projects/seminars

15

Number of credit points

4

Lecturers

Responsible for the course/lecturer:

Mieczysław Porowski, PhD. Dr.Sc. Associate Prof.

email: mieczyslaw.porowski@put.poznan.pl

tel. 61,665-2414

Faculty of Environmental Engineering and Energy

Berdychowo 4, 61-131 Poznań

Responsible for the course/lecturer:

Prerequisites

1. Knowledge:

Basic knowledge of mathematics, physics, chemistry and biology as a tool for understanding mathematical transformations and identification as well as assessment of the chemical and microbiological pollutants in air.

Basic knowledge of thermodynamics, heat transfer and fluid mechanics in the thermodynamics of moist air, theory of infiltration, conductivity, heat transfer and fluid dynamics.

2. Skills:

The ability to perform mathematical transformations, derivation of mathematical equations and solving classical regular differential equations.

The ability to perform hydraulic calculations, heat loss calculation and making drawings in AutoCAD software.

3. Social competencies:

Awareness of the need to constantly update and complement knowledge and skills.

Course objective

Expanding knowledge of the theoretical basis and practical solutions of indoor ventilation systems and ventilation devices as well as basis of selection and operation of ventilation systems for variable types of rooms.

Course-related learning outcomes

Knowledge

1. Student has knowledge about the systematic of widely understood comfort climate, determining of ventilation loads, especially sensible heat gains, moisture gains, pollution and the methods of determining the amount of ventilation air (obtained during the lecture and auditorium exercises) - [KIS_W01, KIS_W02, KIS_W03, KIS_W04]

2. Student knows the basic structures of mechanical ventilation systems: supply, exhaust, supply-exhaust, including systems with heat recovery from the exhaust air (obtained during the lecture and auditorium exercises) - [KIS_W02, KIS_W04, KIS_W05, KIS_W07]

3. Student has knowledge about the characteristics of all air handling unit components, especially: air filters, heaters, heat recovery exchangers, fans (obtained during the lecture) - [KIS_W03, KIS_W04]

4. Student has knowledge about the aerodynamic calculation of air systems, including pressure losses and system characteristics determination, fan and duct system cooperation as well as efficiency regulation methods of this system (obtained during the lecture and auditorium exercises) - [KIS_W03, KIS_W04]

5. Student knows the basic indoor air distribution systems, supply air and exhaust air diffusers (obtained during the lecture) - [KIS_W02, KIS_W03, KIS_W04]

6. Student has the general knowledge about room acoustics as well as acoustic calculation and silencer selection rules (obtained during the lecture) - [KIS_W02, KIS_W07]

7. Student knows the mathematic models and natural ventilation solutions of industrial halls, including aeration (obtained during the lecture) - [KIS_W03, KIS_W04]

8. Student knows the basic structures of exhaust hoods systems used in industrial ventilation, methods and sizing of them as well as applications (obtained during the lecture and auditorium exercises) - [KIS_W04, KIS_W05, KIS_W07]

Skills

1. Student can set loads emission, including sensible heat gains and moisture gains calculation as a loads for ventilation system, air volume calculation for determined and undetermined loads emission (obtained on the auditorium and project exercises) - [KIS_U01, KIS_U04, KIS_U10]

2. Student can perform a calculations for the indoor air distribution systems as a tool for supply air and exhaust air diffusers selection (obtained on the project exercises) - [KIS_U01, KIS_U02, KIS_U03, KIS_U04]

3. Student can perform a heat efficiency calculations for the heater in air handling unit taking into account a heat exchangers efficiency including exhaust air recovery, presenting interpretation of calculations on the h-x graph (obtained on the auditorium and project exercises) - [KIS_U04, KIS_U10]

4. Student can perform a aerodynamic calculations of air system, duct sizing, pressure losses calculation as well as calculate set point for fan-duct system structure (obtained on the auditorium and project exercises) - [KIS_U04, KIS_U10,KIS_U15]

5. Student can perform a calculations for exhaust hood, suction nuzzles or covers selection (obtained on the project exercises) - [KIS_U04, KIS_U15]

6. Student can use a manufacturers catalogues as well as perform devices selection based on graphs and software (obtained on the project exercises) - [KIS_U01, KIS_U02]

7. Student can perform drawings in AutoCAD technique - design (obtained on the project exercises) - [KIS_U01, KIS_U02, KIS_U04, KIS_U10]

8. Student can see the need of continuous broadening and enhancement of their competencies (obtained on the auditorium and project exercises) - [KIS_U17]

Social competences

1. Student is aware of the impact of indoor climate comfort on human well-being (obtained on the auditorium) - [KIS_K01, KIS_K05, KIS_K06]

2. Student is aware of the importance of ventilation as a part of the technical building equipment affecting the human health and safety (obtained on the auditorium and project exercises) - [KIS_K01, KIS_K05, KIS_K06]

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

> Lecture

- written examination (educational results: W01,W02,W03,W04,W05,W07,U01,U04):

duration: 90 min, test of skills (1 task), test of knowledge (8 questions), max. 55 points, admission to the oral exam min. 50% of max. number of points

- oral examination (supplementary questions).

Project (effects: U01, U02, U03, U04, U10, U11, U15)

Individual project - the ability to choose the subject in terms of the location of the building and the purpose of the room. The project consists of 4 tasks, each task is assessed on the basis of on time (10-20% of the grade), project consultation (individual work grade) (10-30% of the grade) and correctness of each part of the project (50-80% of the grade)). Each part of the project is subject to evaluation. Each part should be scored as a separate, positive grade, and the final grade is the average grade from 4 tasks. The credit threshold for each task is determined separately, with a minimum of 50% of points for the correct performance of the task.

Programme content

Ventilation and air conditioning - definition, classification. Outdoor climate parameters. Climate comfort parameters incl. thermal comfort, Fanger's equation. Indoor air quality: carbon dioxide emission, dust, microbes, aerosols, NDS. Ventilation and air conditioning loads: sensible heat gains, moisture gains, pollutant emissions. Air volume calculation for determined and undetermined loads emissions. Indoor air distribution systems: air stream classification and characteristics, supply air and exhaust air diffusers. Air distribution systems in special rooms. Duct sizing, pressure lines. Elements of air handling unit and ventilation system - calculation and selection: fans, filters, heaters, heat exchangers (recuperators, rotary regenerators), silencers, outdoor air intakes, exhaust air dischargers, dampers, fire dampers. Acoustics of air systems - general issues. Noise sources, own attenuation of the system, acoustic calculation and silencer selection. Natural and mechanical system of ventilation structures. Ventilation systems division in industry. Aeration - mathematic models, technical solutions. Local exhaust - sizing rules of exhaust hoods, suction nuzzles, covers and ducts. Air cleaners in industrial ventilation. Air curtains - classification, sizing, applications. Ventilation systems for various type of industry.

The topics of the tutorials include the tasks of: calculating the air flow from various criteria, selecting the supply air parameters, equation of disappearance of pollutants, power balance of devices (heat exchangers, air heater), air recirculation, pressure lines in the ventilation system, aerodynamic regulation of the installation..

Topics of project: the design of a ventilation system for a selected open-space room. The project includes: selection of indoor air parameters, selection of ventilation air stream, design of air distribution, selection of supply and exhaust elements, exhaust air intake, selection of ventilation unit, hydraulic calculations of the installation, verification of the selection of fans, installation drawings (installation diagram in axonometry, plans of the installation in the room and engine room, sections of the installation in the room and engine room, and sections of shafts).

Teaching methods

An informative lecture, a lecture with a multimedia presentation, a problem lecture. Design tutorials: presentation of solutions of analytical and design issues, case studies, consultation of individual solutions.

Bibliography

Basic

1. W. Stankiewicz, J. Wojtowicz, Zadania z matematyki dla wyższych uczelni technicznych, PWN, część pierwsza i druga, Warszawa.

2. M. Gewert, Z.Skoczylas, Analiza matematyczna 1. Definicje, twierdzenia, wzory. Oficyna Wydawnicza GiS.

3. I. Foltyńska, Z. Ratajczak, Z. Szafrański, Matematyka część I i II, Wydawnictwo Politechniki Poznańskiej.

4. W. Stankiewicz, J. Wojtowicz, Zadania z matematyki dla wyższych uczelni technicznych, PWN, część pierwsza i druga, Warszawa.

5. M. Gewert, Z.Skoczylas, Analiza matematyczna 1. Definicje, twierdzenia, wzory. Oficyna Wydawnicza GiS.

6. I. Foltyńska, Z. Ratajczak, Z. Szafrański, Matematyka część I i II, Wydawnictwo Politechniki Poznańskiej.

7. Przydróżny S.: Wentylacja. Wydawnictwo Politechniki Wrocławskiej. Wrocław 1991.

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

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

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

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

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

Additional

1. E. Swokowski, Calculus with analytic geometry, Prindle, Weber; Schmidt, Boston, Massachusetts.

2. W. Krysicki, L.Włodarski,Analiza matematyczna w zadaniach, PWN, Warszawa.

3. E. Swokowski, Calculus with analytic geometry, Prindle, Weber; Schmidt, Boston, Massachusetts.

4. W. Krysicki, L.Włodarski,Analiza matematyczna w zadaniach, PWN, Warszawa.

5. Mizieliński B.: Systemy oddymiania budynków. WNT Warszawa 1999.

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

7. 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	100	4,0
Classes requiring direct contact with the teacher	60	2,5
Student's own work (literature studies, preparation for tutorials, preparation for tests/exam, project preparation) [1]	40	1,5

[1] delete or add other activities as appropriate