Air conditioning and ventilation systems

Course description

The goal of the course "Air conditioning and ventilation systems" is to allow students to gain knowledge and to develop some hands-on experience in air conditioning and ventilation systems design. Throughout the course, we will cover such areas as indoor air quality in civic and industrial buildings, indoor sources of pollution, heat and humidity, calculation methods for air conditioning and ventilation, methods for optimization of ventilation systems. The course is mandatory for trainings in power engineering, since it teachers how to select methods and systems for industrial/civil air-conditioning. We will highlight the specifics of each calculation method applied for the ventilation and air-conditioning systems and will give certain examples using a case study of industrial/civic installations. Students will be able to train their skills in our labs with real-life industrial equipment.

The main objectives of the discipline are to acquaint students with thermodynamics of the air processes in air conditioning equipment; with air conditioning and ventilation systems installed for industrial facilities designed for various purposes, and most appropriate calculation methods for these systems; with IAQ (indoor air quality) analysis in civic buildings (basic indoor air pollutants, building factors affecting indoor air quality and their correlation with the level of humidity and temperature).

Learning Outcomes

Upon completion of this course, students are expected to:

- be able to design the individual air-conditioning/ventilation units and air-conditioning/ventilation systems to meet the desired requirements;
- be able to test, install, operate and maintain HVAC-equipment;
- be able to predict a HVAC-system failure and to start predictive maintenance;
- be able to choose the most appropriate calculation method according to the air conditioning system installed; to perform calculations with the help of i-d diagram;
- to be able to choose the most appropriate air-conditioning/ventilation system in compliance with the set norms and regulations;
- to use mathematical algorithms for the design of heat and mass transfer systems; to be well – versed in the dependencies on which the calculations are based;
- to choose the optimal operation mode for the indoor equipment and the most appropriate indoor equipment on the basis of IAQ-analysis
- to be able to prepare technical reports for maintenance and repair.

Scope and types of study, the contents of the discipline

The course is worth 4 ECTS credits or 144 hours (which include 32 hours of lectures, 16 hours of supervised lab practice, 16 hours of supervised workshops, 80 hours of self-study lab work).

Contents, the types of classes and the workload

Module number	Contents	Workload according to the types of work (hours)			
		total	L	WS	LP
1	The main types of ventilation equipment. Types of air distribution systems. Indoor Air Quality (IAQ) – analysis: types of indoor air pollutants.	13	10	3	0
2	Humid air properties. I-d diagram for humid air.	19	6	5	8
3	Indoor air quality (IAQ) of industrial and civil buildings.	13	10	3	0
4	Humidity calculations by i-d diagrams. Ventilation and air conditioning systems design.	19	6	5	8
Total		64	32	16	16

Contents of the modules

Module number	Titles of the modules	Contents of the modules
1	The main types of ventilation equipment. Air properties. Changes in the air properties inside a building	1 Classification of air ventilation equipment. 2 Air properties inside a building. 3 Local and general ventilation.
2	Indoor air quality in buildings	1 Heat 2 Humidity 3 Gaseous and solid emissions.
3	Humid air properties	1 The definition of air absolute and relative humidity 2 The definition of enthalpy and heat capacity of humid air 3 I d diagram for humid air
4	Processes in humid air	1 The line of process in I d diagram 2 Special typical processes in humid air
5	Air processing in a central air conditioning system	1 Processes in irrigation chamber of a central conditioning unit

6	Air conditioning processes: air recirculation Calculation methods used for systems of air conditioning	1 Calculation the air conditioning process: the first step recirculation 2 Calculation the air conditioning process: the second step recirculation
7	Equipment for a central conditioning unit	1 Calculation methods for ventilation equipment 2 Calculation methods for heat exchanging equipment
8	Design of an air conditioning system	1 Calculation of heat and humid balance in a building 2 Selecting calculation methods and equipment for central air conditioning system.

Contents of the workshops

Number of WS	Module number	Contents of the workshops	Workload (hours)
1	2	Calculating indoor air temperature and humidity in a building.	4
2	2	Selecting the equipment for air ventilation system	4
3	3	Calculation methods for a simple air conditioning system.	4
4	3	Calculation methods for an air conditioning system with recirculation	4

Contents of the lab classes

Number LP	Module number	Contents the laboratory practice	Workload (hours)
1	2	The study of humid air properties.	8
2	3	The study of an air conditioner unit operation inside civil buildings.	8

Grading policy

Forms of Control:

Type of assessment	%
Continuous assessment (lectures):	20
Continuous assessment (lab practice)	65
Final Exam (project)	15