STUDY MODULE DESCRIPTION FORM

Name of the module/subject **Diagnostic and studies of HVAC systems**			Code **1010101261010105184**
Field of study **Environmental Engineering First-cycle Studies**	Profile of study (general academic, practical) **(brak)**		Year /Semester **3 / 6**
Elective path/specialty **-**	Subject offered in: **Polish**		Course (compulsory, elective) **elective**
Cycle of study: **First-cycle studies**	Form of study (full-time,part-time) **full-time**		
No. of hours Lecture: **15** Classes: **15** Laboratory: **-** Project/seminars: **15**			No. of credits **4**
Status of the course in the study program (Basic, major, other) **(brak)**	(university-wide, from another field) **(brak)**		
Education areas and fields of science and art **technical sciences**			ECTS distribution (number and %) **4 100%**

Responsible for subject / lecturer:

dr inż. Radosław Górzeński
email: radoslaw.gorzenski@put.poznan.pl
tel. +48 (61) 6660298
Faculty of Civil and Environmental Engineering
ul. Piotrowo 5 60-965 Poznań

Responsible for subject / lecturer:

dr inż. Radosław Górzeński
email: radoslaw.gorzenski@put.poznan.pl
tel. +48 (61) 6660298
Faculty of Civil and Environmental Engineering
ul. Piotrowo 5 60-965 Poznań

Prerequisites in terms of knowledge, skills and social competencies:

1	**Knowledge**	Student has knowledge of thermodynamics, heat transfer and fluid mechanics, ventilation - in the field of moist air thermodynamics, the heat transfer, conductivity, air flows of indoor air and air flows in air handling units.
2	**Skills**	Student has the ability to perform mathematical calculations, formulate mathematical formulas and solving classic linear and ordinary differential equations. Ability to perform hydraulic, heat losses and cooling loads calculations, and create engineering drawings in AutoCAD.
3	**Social competencies**	Student should be aware of decisions consequences. Be aware of the need to constantly update and supplement knowledge and skills. Be aware of the theoretical and practical knowledge strength.

Assumptions and objectives of the course:

The aim of the course is to familiar students with the research and diagnostics methods of heating, ventilation and air conditioning systems as part of commissioning, inspection or verification. The aim of the course is to develop skills to supervise and carry out tests and interpret the results.

Study outcomes and reference to the educational results for a field of study

Knowledge:

1. The graduate has an knowledge in the field of fluid mechanics within ducts - [K_W03, K_W07]
2. Student ma wiedzę w zakresie szczelności powietrznej kanałów i budynków - [K_W02]
3. The graduate has an knowledge in the field of ducts - [K_W03]
4. The graduate has an knowledge in the field of materials and technology used in air and water systems - [K_W03]
5. The graduate knows techniques and tools used in solving simple engineering tasks, including selection of structures for heating, ventilation and air conditioning (HVAC) systems for buildings - [K_W07]
6. The graduate has a basic knowledge of technical systems, facilities and appliances lifespan - [K_W06]
7. The graduate has a basic knowledge of development trends in the field of environmental engineering including technical systems for buildings - [K_W05]

Skills:

1. The graduate can interpret the results of experiments obtained, draw conclusions and formulate and justify opinions - [K_U01, K_U08]
2. The graduate can perform experiments and prepare report with description of methodology, circumstances and measurement results for technical systems for buildings, including heating and cooling systems - [K_U02, K_U08]
3. The graduate can perform experiment measurements of pressure, temperature, water/air flows, heat flux, heat exhanger capacity - [K_U09]
4. The graduate can make a critical analysis of the functioning and evaluate the existing technical solutions in the field of environmental engineering, in particular equipment, facilities, systems, processes, services related to technical systems and installations for buildings, central heating supply, thermal networks, water supply and sewage - [K_U13]

Social competencies:

1. The graduate can cooperate and work in a team - [K_K03]
2. The graduate is aware of the need to repeat the measurements and evaluating the uncertainty of measurement results - [K_K05]
3. The graduate understands the need of lifelong learning and improvement of competence - [K_K01]

Assessment methods of study outcomes

Lectures

A two-part written exam, date stated at the beginning of the semester.

Part 1. Verification of the knowledge, involves answering a few questions. In cases of doubt, extended oral exam is possible.

Part 1. Checking the skills, involves solving tasks and performing basic calculations.

Activity of the students is required at each lecture.

Tutorials

45-minute written exam in the last week of the semester, solving tasks and performing basic calculations.

Evaluating the correctness and independent own student work.

Continuous assessment for each tutorial (rewarding activity).

Course description

Air flows measurements (thermoanemometers, Pitot tubes, utilization of VAV and BMS)
Ventilation system adjusting and regulation (balometers, diffusers' pressure sockets)
Heat demand measurements (heat meters)
Flow measurements (water systems, rotameters, balancing valves - differential pressure measurement)
Pressure measurement (elements' pressure drop)
IAQ measurements (CO2, humidity, temperature, laser particle counter)
Meteorological measurements (outdoor)
Microbiological measurements (air and water systems)
Measurements of fan coil units and splits performance
Boilers' efficiency measurements
Duct leakages measurements
Radiators and heat exhangers measurements
Air tightness measurements (n50, Blower Door)
Fire protection system measurements (jet fans, smoke tests)
Filters measurements (bacteriology, dust)
Electrical measurements (fan motors, compressors, refrigeration systems and heat pumps)
Complex parameters measurements (heat recovery efficiency, COP, ESEER)
IR thermographic measurements
Building Management System use for diagnostic
Benchmarking
Communication protocols and automation components
Acoustic measurements
Analysis of measurement data of different accuracy (eg. invoices, periodic heat meters readings, continuous monitoring, BMS)
The users impact (method of assessing the usage level of the building, video surveillance, gate counters, schedule profiles)
The use of diagnostic on reducing operating costs

Basic bibliography:

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

Additional bibliography:

1. Wymagania techniczne COBRTI INSTAL Zeszyt 5.
2. Wymagania techniczne COBRTI INSTAL Zeszyt 6.
3. Wymagania techniczne COBRTI INSTAL Zeszyt 8.

Result of average student's workload

Activity	Time (working hours)
1. Participation in lectures	15
2. Participation in tutorials	15
3. Preparation for the laboratory exercises	10
4. Participation in consultations	3
5. Preparation for the exam and the present at the exam	20

Student's workload

Source of workload	hours	ECTS
Total workload	100	4
Contact hours	50	2
Practical activities	65	2