Table S2.6.4. Form for the preparation of the course information sheets

Name of the subject: Power analyses in HVAC systems

Code of the subject	Status of the subject	Semester	Number of ECTS credits	Class load
	Optional		10	3+1+1

Study programme for which it is organized: Doctoral studies in sustainable development, MARDS

Dependency by other subjects: None

Objectives of studying this subject:
The basic idea of studying the subject is to get acquainted with the methods of exergetic analysis of buildings and plants. Exergy contains the principles of 2nd law of thermodynamics as the most important law of physics, while understanding and energy analysis by using its principles is of great importance from the point of view of sustainability above all. After mastering this subject and topics, a better picture of energy consumption is obtained, but now from a different angle, which includes the question of the sustainability of the latest technologies for the use of energy in all sectors of consumption.

Contents of the subject (teaching units, forms of students' individual work, forms of testing) presented per working weeks in the academic calendar:

Preparatory week	Semester preparation and enrolment.
I week	The concept of exergy. Definition of heat exergy, mechanical energy, electrical energy. Exergetic and energy efficiency. Exergy and sustainability. Exergy, environment and sustainability.
II week	Energy and exergy analysis. Heat exchangers. Efficiency analyzes. Heat exchanger efficiency.
III week	Exergetic analysis of installation and process elements (pumps, compressors, valves, mixing of currents, phase switch).
IV week	Exergy and industrial heating and cooling. Renewable heating and cooling. Industrial heat pumps.
V week	Combustion-based heating and exergetic analysis. Electric process heating. Heating based on steam systems. Case studies.
VI week	Exergy and heat pumps. Efficiency of heat pumps. Seasonal heating factor. Seasonal energy efficiency factor.
VII week	Classification of heat pumps. Energy and exergy analysis of evaporative compressor heat pumps.
VIII week	Colloquium 1
IX week	Cogeneration plants. Case studies and exergetic analyzes. Energy and exergy efficiency of cogeneration. Impact of cogeneration on emissions and the environment.
X week	Remote heating and cooling based on cogeneration. Exergetic analysis. Case studies.
XI week	Energy storage systems. Classification of energy storage systems. Thermodynamic analyzes of energy accumulators.
XII week	Charging the battery. Battery discharge. Environmental impact and exergetic analysis.
XIII week	Refrigeration and air-conditioning systems based on renewable energy sources. Case studies. Energy and exergy analysis of renewable energy sources and air conditioning systems as an integral system.
XIV week	Optimization methods based on exergetic analyzes. Case studies. Wind, solar, diesel, natural gas.
XV week	Colloquium II

Methods of education:

- Lectures
- Interactive exercises
- Team and individual project.

Students' load

Weekly	In Semester
10 credits x 40/30 = 13 hours and 30 minutes Structure: 3 hours of lectures 2 hours of exercises 1 hour and 20 minutes of independent work including consultations	Teaching and final exam: (13 hours 30 minutes) x 15 = 200 hours Necessary preparations before the beginning of the semester (administration, enrollment): 2 x (10 hours and 30 minutes) = 21 hours Total load for the subject: 5x30 = 150 hours Additional work for exam preparation in the remedial exam period, including taking the remedial exam: 36 hours and 55 minutes Load structure: 99 hours and 45 minutes (classes) +13 hours and 20 minutes (preparation) +36 hours and 55 min (additional work)

Students' obligations during the teaching:

- regularly attends classes and exercises
- conscientiously and independently realize seminar papers or homework
- works in a team
- independently completes the practical part of the exam, with the help of literature
- presents the acquired knowledge and achieved results

Literature:

- [1] I. Dincer, M. A. Rosen : Exergy Analysis of Heating,Refrigerating, and Air Conditioning, Elsevier publishing, 2015.
- [2] Kostas, T.J., The Exergy Method of Thermal Plant Analysis, Paragon Publishing, 2012.

Learning outcomes (complied with the outcomes for the study programme):

1. understand and master the basic theoretical knowledge of thermodynamics
2. understand the concept of energy and exergy analysis, exergy
3. analyze different cases in different energy installations
4. conduct and perform energy and exergy analysis of various energy installations

Forms of tests and evaluation:

1st colloquium 25 points, 2nd colloquium 25 points, final exam 50 points;
A passing grade is obtained if at least 50 points are cumulatively collected;

Name and surname of teacher and associate:

Prof. Igor Vusanovic, PhD

Particularities needed to be emphasized for the subject:

The course is recommended to those who will deal with energy analysis and energy savings in all sectors.

Note (if needed):