Center for Interdisciplinary and Multidisciplinary Studies / / Power analyses in HVAC systems

Course:	Power analyses in HVAC systems			
Course ID	**Course status**	**Semester**	**ECTS credits**	**Lessons** (Lessons+Exercises+Laboratory)
13753	Optional	1	10	4+2+1
Programs				
Prerequisites	No.			
Aims	Introducing with modern techniques of exergetic analysis of HVAC installations			
Learning outcomes	1. to understand and master the basic theoretical knowledge of Thermodynamics 2. to understand the concept of energy and exergy analysis, exergy 3. to analyze different cases in various energy installations 4. to conduct and perform energy and exergetic analysis of various energy installations			
Lecturer / Teaching assistant	Prof. dr Igor Vušanović, doc. dr Esad Tombarević			
Methodology	Lectures and laboratory exercises			
Plan and program of work				
Preparing week	Preparation and registration of the semester			
I week lectures	The concept of exergy. Definition of exergy heat, mechanical energy, electrical energy. Exergetic and energy efficiency. Exergy and sustainability. Exergy, environment and sustainability.			
I week exercises				
II week lectures	Energy and exergetic analysis. Heat exchangers. Efficiency analyses. Heat exchanger efficiency.			
II week exercises				
III week lectures	Exergy analysis of installation and process elements (pumps, compressors, valves, flow mixing, phase change)			
III week exercises				
IV week lectures	Exergy and industrial heating and cooling. Renewable heating and cooling. Industrial heat pumps.			
IV week exercises				
V week lectures	Heating based on combustion and exergy analysis. Electrical process heating. Steam based heating systems. Case studies.			
V week exercises				
VI week lectures	Exergy and heat pumps. Efficiency of heat pumps. Seasonal heating factor. Seasonal energy efficiency factor.			
VI week exercises				
VII week lectures	Klasifikacija toplotnih pumpi. Energetska i eksergetska analiza kompresorskih toplotnih pumpi sa isparavanjem.			
VII week exercises				
VIII week lectures	Colloquium 1			
VIII week exercises				
IX week lectures	Cogeneration plants. Case studies and exergy analysis. Energy and exergy efficiency of cogeneration. The impact of cogeneration on emissions and the environment.			
IX week exercises				
X week lectures	District heating and cooling based on cogeneration. Exergy analysis. Case studies.			
X week exercises				
XI week lectures	Energy storage systems. Classification of energy storage systems. Thermodynamic analyses of energy accumulators.			
XI week exercises				
XII week lectures	Charging of the energy storage. Discharging of the energy storage. Impact on the environment and exergy analysis.			
XII week exercises				

XIII week lectures	Cooling and air conditioning systems based on renewable forms of energy. Case studies. Energy and exergy analysis of RES and the air conditioning system as an integral system.
XIII week exercises	
XIV week lectures	Optimization methods based on exergy analyses. Case studies. Wind, solar, diesel, natural gas.
XIV week exercises	
XV week lectures	Colloquium 2
XV week exercises	
Student workload	Weekly: 6 credits x 40/30 = 8 hours Structure: - 2 hours of lectures; - 2 hours of exercises; - 5 hours and 40 minutes of independent work, and consultations

Per week	**Per semester**
10 credits x 40/30=13 hours and 20 minuts 4 sat(a) theoretical classes 1 sat(a) practical classes 2 excercises **6 hour(s) i 20 minuts** of independent work, including consultations	Classes and final exam: **13 hour(s) i 20 minuts x 16 =213 hour(s) i 20 minuts** Necessary preparation before the beginning of the semester (administration, registration, certification): **13 hour(s) i 20 minuts x 2 =26 hour(s) i 40 minuts** Total workload for the subject: **10 x 30=300 hour(s)** Additional work for exam preparation in the preparing exam period, including taking the remedial exam from 0 to 30 hours (remaining time from the first two items to the total load for the item) **60 hour(s) i 0 minuts** Workload structure: **213 hour(s) i 20 minuts (cources), 26 hour(s) i 40 minuts (preparation), 60 hour(s) i 0 minuts (additional work)**
Student obligations	Students are required to attend classes and do colloquiums
Consultations	
Literature	Literatura: [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.
Examination methods	Testing and assessment: I colloquium 25 points, II colloquium 25 points Final exam 50 points A passing grade is obtained if at least 50 points are accumulated cumulatively
Special remarks	
Comment	

Grade:	F	E	D	C	B	A
Number of points	less than 50 points	greater than or equal to 50 points and less than 60 points	greater than or equal to 60 points and less than 70 points	greater than or equal to 70 points and less than 80 points	greater than or equal to 80 points and less than 90 points	greater than or equal to 90 points