RTU Course "Advanced Energy Technologies"

11509 Vides aizsardzības un siltuma sistēmu katedra

General data

Code	EAS706
Course title	Advanced Energy Technologies
Course status in the programme	Compulsory/Courses of Limited Choice
Course level	Post-graduate Studies
Course type	Academic
Field of study	Environmental Engineering and Management
Responsible instructor	Ivars Veidenbergs
Academic staff	Agris Kamenders Aivars Žandeckis
Volume of the course: parts and credits points	1 part, 6.0 Credit Points, 9.0 ECTS credits
Language of instruction	LV, EN
Possibility of distance learning	Not planned
Abstract	Course “Advanced Energy Technologies” deal with different energy technologies and their technical and environmental performances. The energy tehnoligies and their primary components boiler, turbomachinery (compressor, turbine, pump), condenser and other heat exchangers are analyzed both in practice and thermodynamically. Models of these as well as the whole plant are made, analyzed and discussed. The construction and the functioning of various auxiliary equipments (coal mills, fans, blowers and burners) are explained. In the course possibilities to reduce emission level and increase energy efficiency is being analyzed.
Goals and objectives of the course in terms of competences and skills	To be able to analyze different energy technologies their technical and environment indicators. Able to formulate, model, and solve problems involving systems and devices having various forms of energy exchange and energy conversion. Model systems, and to be able to identify sub-systems and components in engineering systems. Discuss thermodynamics in a logical and general way.
Structure and tasks of independent studies	Literature research work about different energy technologies. Assignments and work with principle shames, energy loud calculation, and boiler energy loses calculation, heat exchanger calculation, H-D diagram analyses, fuel gas condensate calculation with help of CATT2 programme, heat pump loud calculation and boiler emission calculation to reference conditions. Presentation and laboratory work.
Recommended literature	1. Blumberga D., Veidenbergs I., Kliedētas energosistēmas. Mazas koģenerācijas stacijas, RTU, 2008 2. Blumberga D. Siltuma sūkņi, RTU, 2008. 3. Nagla J., Saveļjevs P., Cieminš R. Siltumtehnikas pamati, R. Zvaigzne, 1981. 4. Nagla J., Saveļjevs P., Cars A. Siltumtehniskie aprēķini piemēros. R. Zvaigzne, 1982. 5. Ganapathy V. Industrial Boilers and Heat Recovery Steam Generators. Designe, Applications and Calculations. 2003. 6. Blumberga D., Energoefektivitāte, Rīga, Pētergailis. 1996. 7. Combustion Fossil Power, 4th ed. Combustion Engineering, INC. 1991. 8. Eastop T.D., Croft D.R. Energy Efficiency. Longman Group, 1995.
Course prerequisites	Knowledge in heat transfer and thermodynamics.

Course outline

Theme	Hours
Energy technology classification and evaluation.	4
Static heat balance. Energy Technology classification.	12
Heat pump classification. Heat pump operation theoretical aspects, COP coefficient and economical aspects.	6
Theory of heat exchangers. Pinch analysis for heat recovery systems.	6
Heat exchangers and gas condensing technologies.	4
Practical works.	48
Laboratory works.	16

Learning outcomes and assessment

Learning outcomes	Assessment methods
Able to calculate processes in energy technologies. Identify sub-systems and components in engineering systems.	The practical work, laboratory work, homework, exam. Criteria: Able to take the heat pump calculation, the calculation of the heat exchanger, heat recovery calculations in technological processes.
Explain the construction and operation of flue gas cleaning systems (particle precipitators, de-sulphurisation and NOx-reduction).	The practical work, laboratory work, homework, exam. Criteria: Ability to calculate the emissions from the boiler.

Ability to identify and apply emissions reduction methods in different energy technologies.	The practical work, laboratory work, homework, exam. Criteria: Able to offer emission reduction methods and calculate the amount of emissions reductions.
Able to make measurements and energy efficiency evaluation for different energy technologies.	The practical work, laboratory work, homework, exam. Criteria: Ability to identify the boiler heat losses, to determine the efficiency and construct a boiler heat balance equation.

Study subject structure

Part	CP	ECTS	Hours per Week			Tests		
			Lectures	Practical	Lab.	Test	Exam	Work
1.	6.0	9.0	2.0	3.0	1.0		*	