RTU Course "Renewable energy sources"

11509 Vides aizsardzības un siltuma sistēmu katedra

General data

Code	EAS723
Course title	Renewable energy sources
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	Gatis Bažbauers
Academic staff	Francesco Romagnoli
Volume of the course: parts and credits points	1 part, 4.0 Credit Points, 6.0 ECTS credits
Language of instruction	LV, EN, RU
Possibility of distance learning	Not planned
Maximum auditorium capacity	50
Maximum number of students per semester	50
Abstract	Renewable energy flow; solar, wind, hydro, ocean waves, tide, geothermal and bio-fuel energy systems. Energy storage and distribution. Integration of renewable energy sources into the energy systems. Planning of energy supply scenarios with increased share of renewables.
Goals and objectives of the course in terms of competences and skills	To train to and analyze renewable energy options and to evaluate technical and environmental aspects of technologies based on renewable energy. To train to characterize renewable energy sources, cross-comparisons and comparisons with non-renewable energy resources on the basis of indicators such as energy intensity, location, time of permanence, security, environmental aspects. To teach to perform calculations related to the issue of renewable energy conversion to electricity and heat.
Structure and tasks of independent studies	Literature research work to characterize the technical aspects various renewable energy systems and the environmental impacts. Practical works-calculations to identify opportunities for renewable energy transformation into electricity and heat, and compare different renewable energy solutions. Practical work in calculations to determine possibility to integrate renewable energy into common energy supply system, the benefits and barriers. Practical work in modelling/developing energy scenarios with the aim to increase the share of renewable energy. Practical work calculations students will perform developing their own mathematical models, as well as using other power system analysis models.
Recommended literature	1. Sorensen B., Renewable Energy, Third Edition, Elsevier Academic Press, 2004 2. Lund H., Renewable energy systems, The choice and Modeling of 100% Renewable Solutions, Elsevier, 2010 3. Boyle G., Everett B. and Ramage J., Energy Systems and Sustainability, Power for a Sustainable Future, Oxford University Press, 2003 4. Breeze P., Power Generation Technologies, Elsevier, 2005 5. Blumberga D., Siltuma sūkņi, RTU izdevniecība, Rīga, 2008 6. Blumberga D., Veidenbergs I., Kliedētas energosistēmas. Mazās koģenerācijas stacijas, RTU izdevniecība, Rīga, 2008 7. Nagla J., Saveļjevs P., Ciemiņš R., Siltumtehnikas pamati, Rīga „Zvaigzne", 1981 8. Autoru kolektīvs Kļaviņa M. redakcijā, Vides zinātne, LU Akadēmiskais apgāds, 2008 Papildus literatūra-periodika: 1. Energy, Elsevier 2. Energy Policy, Elsevier, ISSN 0301-4215 3. Renewable and Sustainable Energy Reviews, Elsevier, ISSN 0304-3800
Course prerequisites	Specific prerequisites are not required.

Course outline

Theme	Hours
Origin of renewable energy flow.	4
Solar energy for electricity production. Practical Work No.1. Solar energy system calculations.	4
Solar energy for heat production. Practical Work No.2. Solar energy system calculations.	4
Wind energy. Practical Work No.3. Wind energy system calculations.	4
Hydroelectricity. Practical Work No.4. Hydroenergy system calculations.	4
Intertidal energy, ocean wave energy. Practical Work No.5. Intertidal energy, ocean wave energy systems.	4
Geothermal energy. Practical Work No.6. Geothermal energy system calculations.	4
Biological energy conversion and storage.	4
Biomass. Practical Work No.7. Biomass energy system calculations.	4
Biofuel. Practical Work No.8. Biofuel system calculations.	4
Biogas. Practical Work No.9. Biogas system calculations.	4

Energy storage and distribution. Practical Work No.10. Energy storage and distribution system calculations.	4
Integration of renewable energy sources into the energy systems. Practical Work No.11. Fluctuating generation sources.	8
Planning of energy supply scenarios to increase the share of renewable energy. Practical Work No.12.	4
Summary of the course, questions, discussions. Defence of the course work assignment.	4

Learning outcomes and assessment

Learning outcomes	Assessment methods
To be able to analyze options to use renewable energy, using general theoretical principles and relationships, which are applicable regardless of a particular technological solution.	Examination: Practical works, course work Assessment criteria: accomplished practical works No.1-9, successful completion and defence of course work.
To be able to describe the renewable energy resources and compare them with non-renewable energy resources, taking into account energy intensity, location, time of permanence, security.	Examination: Practical works, course work Assessment criteria: accomplished practical works No.1-9, successful completion and defence of course work.
To be able to evaluate and compare technical and environmental aspects of the various technological solutions based on renewable energy.	Examination: Practical works, course work Assessment criteria: accomplished practical works No.1-9, successful completion and defence of course work.
To be able to make calculations of conversion processes for renewable energy.	Examination: Practical works, course work Assessment criteria: accomplished practical works No.1-9, successful completion and defence of course work.
To be able to perform calculations related to the integration of renewable energy sources into energy supply systems combining them with other energy conversion, hydrogen technology and transportation	Examination: Practical works Assessment criteria: accomplished practical works No.10-12.
To be able to analyze power system scenarios with varying proportion of renewable energy and technological solutions.	Examination: Practical and course work Assessment criteria: accomplished practical work No.12, successful defence of course work. The knowledge level will be evaluated in the final examination.

Study subject structure

Part	CP	ECTS	Hours per Week			Tests		
			Lectures	Practical	Lab.	Test	Exam	Work
1.	4.0	6.0	2.0	2.0	0.0		*	