

Sheet course ()

Course	MSc IN MECHANICAL ENGINEERING		
Unit	Renewable Energy Applications	Mandatory	<input type="checkbox"/>
		Optional	<input checked="" type="checkbox"/>
Unit scientific area	Thermofluids and Energy	Category	B

Unit category: B - Basic; C - Core Engineering; E - Specialization; P - Complementary.

Year: 1st	Semester: 2nd		ECTS: 5,0			
Contact time	Total:	T:	TP: 45,0	PL:	S:	OT:

T - Lectures; TP - Theory and practice; PL - Lab Work; S - Seminar; OT - Tutorial Guidance.

Unit Director	Title	Position
João Antero Nascimento dos Santos Cardoso	Degree	Invited Associate Professor

Learning Objectives (knowledge, skills and competences to be developed by students)

(max. 1000 characters)

The Curricular Unit has the following basic objectives:

- Provide an integrated view of the energy sector and environmental policy in the EU and, in particular, of Portugal;
- Identify and analyze the different current renewable energy technologies and applications;
- Provide the opportunity to design a project for a real application in the field of solar thermal energy.

The skills that students should acquire are:

- The ability to analyze the EU energy policies, which are converted into directives, regulations and decisions of the EU, as well as the plans, Regulations and legislation in Portugal, and its projection for the future;
- The ability to identify and characterize the different renewable energy technologies;
- The ability to design, calculate, size and select equipment for thermal solar installations of real application for production and storage of sanitary hot water.

Syllabus

(max. 1000 characters)

EUROPEAN ENERGY POLICY:

In the European Union and Portugal

RENEWABLE ENERGY:

Presentation, characterization and discussion of the various technologies and sources of renewable energy:

- Wind energy
- Ocean energy
- Hydropower or Hydro Energy
- Geothermal Energy
- Biomass
- Co-generation
- Fuel cells

SOLAR ENERGY:

Solar radiation and its characterization:

- Properties of Light - Electromagnetic radiation (Spectral and Global)
- Solar Radiation – Solar energy that reaches the Earth
- Earth's Movement around the Sun - Sun-Solar Declination, Solstices and Equinoxes
- Solar radiation Incident on a plane with a particular orientation and inclination

Solar Thermal collection by solar collectors:

- Flat (Selective or non-selective)
- CPC
- Vacuum tubes

Solar Capture by photovoltaic cells

DESIGN OF A REAL INSTALLATION:

Visit to a solar installation;

Design, calculation, sizing and selection of equipment for a solar installation of practical application for production of sanitary hot water.

Demonstration of consistency of the syllabus with the objectives of the course

(max. 1000 characters)

The basic objectives coincide broadly with the syllabus, namely:

1. In order to provide an integrated view of the energy sector and EU environmental policy and, particularly, of Portugal – Presentation of the energy policy in the EU and in Portugal;
2. In order to identify and analyze the different renewable energy technologies and applications that currently exist - Presentation, characterization and discussion of various technologies and renewable energy sources; Description of the solar radiation and its characterization; Solar Thermal solar collectors energy capture methodology; Photovoltaic cells Solar capture.
3. In order to provide the opportunity to develop a project for a real application in the field of solar thermal energy - Visit to a thermal solar installation; Design of a solar thermal plant project of practical application of production and storage of sanitary hot water.

Teaching methodology (evaluation included)

(max. 1000 characters)

Teaching methodology:

The methodology of teaching is based on classroom training, which provides the theoretical and practical components via the bibliography support of the curricular unit (CU), PowerPoint presentations, supplementary material to support the CU in Moodle, computer applications for calculation of solar thermal energy (SOLTERM), monitoring of students in its step-by-step design tasks, calculation, sizing and selection of solar thermal plant equipment to be covered by an individual work.

Evaluation of knowledge:

Individual Work on a chronological presentation development of directives, regulations and decisions of the EU, as well as the plans, Regulations and legislation in Portugal, and its projection for the future – relative weight 10%

Individually Work or in group, to be delivered in MOODLE platform, consisting of a solar project for practical application of thermal solar design for the production and storage of hot water – relative weight 90%

Demonstration of consistency of teaching methods with the learning objectives of the course

(max. 3000 characters)

The basic objectives coincide in a manner directly with teaching and evaluation methodologies, namely:

1. In order to provide an integrated view of the energy sector and EU environmental policy and, particularly, of Portugal – The teaching methodology includes classroom training in its theoretical and practical component, being subsequently proposed the holding of an Individual work with a relative weight of 10% in the end grade;
2. In order to identify and analyze the different renewable energy technologies and applications currently existing – The teaching methodology provides PowerPoint presentations, as well as supplementary material to support the Moodle platform;
3. In order to provide the opportunity to develop a project for practical application in the field of solar thermal energy – The teaching methodology includes a visit to a solar thermal installation, as well as proposing the elaboration of an individual work, consisting of a thermal solar project for practical application of production and storage of hot water, with a relative weight of 90% in the final grade.

Main Bibliography

(max. 1000 characters)

Written Documentation:

Green paper-a European strategy for sustainable, competitive and secure energy, SEC (2006)

Energy efficiency action plan, COM (2006)

Energy efficiency, target of 20%, COM (2008)

Energy Roadmap to 2050, COM (2011)

National action plan for energy efficiency, Portugal 2005 Efficiency (resolution of the CM No. 80/2008)

Course for solar systems installation, INETI (2004)

Training course for Qualified Expert RCCTE/RSECE specialists in air conditioning engineers

ASHRAE Handbook, HVAC Systems and Equipment (2012), Chapter 7, Combined Heat and Power Systems, Chapter 36, Solar Energy Equipment

Internet:

www.erse.pt

www.awea.org



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www.energiasrenovaveis.com

www.apren.pt

<http://re.jrc.ec.europa.eu/pvgis>

<http://dawnsun.net/astro/suncalc>

www.certif.pt/certificacao1.asp

www.estif.org/solarkeymark

www.aguaquentesolar.com/observatorio/equipamentos/colectores.aspt