Universitat de Lleida

DEGREE CURRICULUM

ENERGY FACILITIES II

Coordination: MARTORELL BOADA, INGRID

Academic year 2023-24

ENERGY FACILITIES II 2023-24

Subject's general information

<table>
<tr><td>Subject name</td><td>ENERGY FACILITIES II</td></tr>
<tr><td>Code</td><td>102312</td></tr>
<tr><td>Semester</td><td>2nd Q(SEMESTER) CONTINUED EVALUATION</td></tr>
<tr><td>Typology</td><td>
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<tr><th>Degree</th><th>Course</th><th>Character</th><th>Modality</th></tr>
<tr><td>Bachelor's Degree in Energy and Sustainability Engineering</td><td>4</td><td>OPTIONAL</td><td>Attendance-based</td></tr>
<tr><td>Bachelor's Degree in Mechanical Engineering</td><td>4</td><td>OPTIONAL</td><td>Attendance-based</td></tr>
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<tr><td>Course number of credits (ECTS)</td><td>6</td></tr>
<tr><td>Type of activity, credits, and groups</td><td>
<table>
<tr><th>Activity type</th><th>PRAULA</th><th>TEORIA</th></tr>
<tr><td>Number of credits</td><td>3</td><td>3</td></tr>
<tr><td>Number of groups</td><td>1</td><td>1</td></tr>
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<tr><td>Coordination</td><td>MARTORELL BOADA, INGRID</td></tr>
<tr><td>Department</td><td>INDUSTRIAL AND BUILDING ENGINEERING</td></tr>
<tr><td>Teaching load distribution between lectures and independent student work</td><td>Classes are attendance-based.
It is considered that the work developed in class represents 40 % of the total students load.</td></tr>
<tr><td>Important information on data processing</td><td>Consult this link for more information.</td></tr>
<tr><td>Language</td><td>English</td></tr>
<tr><td>Distribution of credits</td><td>Dr Ingrid Martorell</td></tr>
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ENERGY FACILITIES II 2023-24

Teaching staff	E-mail addresses	Credits taught by teacher	Office and hour of attention
MARTORELL BOADA, INGRID	ingrid.martorell@udl.cat	7,2	

Subject's extra information

Facilities II is an optional second semester course in GEM and GEES and it is part of the optional facilities courses offered.

This course requires continuous work throughout the semester in order to achieve the goals. It is recommended to visit the area frequently associated with the Virtual Campus course, because it announces all the information in it. We recommend using direct mail instead of the teacher's personal use only Messaging Virtual Campus.

It is important that students have knowledge of thermodynamics to do the course.

Learning objectives

- To show good english level in both regular classes and evaluation activities.
- To show learning skills needed to access to a master or other superior studies.
- To work in group in both regular classes and evaluation activities.
- To perform climatization installation calculus.
- To study systems of generation of energy such as combustion, conventional energies (nuclear, fossil fuels,....) as well as more complex systems such as cogeneration ones.
- To demonstrate good skills and critical thinking when analyzing energetic systems.

Competences

- **CB2**. That students know how to apply their knowledge to their work or vocation in a professional way and possess the skills that are usually demonstrated through the elaboration and defense of arguments and the resolution of problems within their area of study.
- **CB4**. That students can transmit information, ideas, problems and solutions to a specialized and non-specialized public.
- **EPS4/CB5**. That the students have developed those learning skills necessary to undertake further studies with a high degree of autonomy.
- **CB5**. That the students have developed those learning skills necessary to undertake further studies with a high degree of autonomy.
- **CG6**. Have adequate knowledge of the concept of the company, the institutional and legal framework of the company and the organization and management of companies.
- **CG15**. Have basic knowledge of production and manufacturing systems.
- **CG16**. To have basic knowledge and application of environmental technologies and sustainability.
- **CG17**. Have applied knowledge of business organization.
- **CE2**. Have applied knowledge of thermal engineering.
- **CE3**. Have applied knowledge of the fundamentals of fluid-mechanical systems and machines.
- **CE12**. To have applied knowledge about renewable energies.
- **CE15**. To acquire the ability to understand, interpret and apply the legislation on energy and environment.
- **CE16**. Acquire capacity to assess the impacts of energy resources through knowledge of the naturalenvironment and conduct energy and environmental audits.
- **UdL2/CT2**. Master a foreign language, especially English.
- **CT3**. Acquire training in the use of new technologies and information and communication technologies
- **CT4**. To acquire basic knowledge of entrepreneurship and professional environments.

- **EPS9**. Capacity for unidisciplinary and multidisciplinary teamwork.
- **GEM-EPS31**. Capacity to design HVAC installations (heating, ventilation and air conditioning).
- **GEM-EPS32**. Applied knowledge to distributed energy generation and energy use.
- **GEM-EPS33**. Capacity of analysis of energy systems, optimization and integration.

Subject contents

1.-CONVENTIONAL ENERGIES

1.1.-FOSSIL FUELS

1.2.-NATURAL GAS

1.3.-OIL

1.4.-NUCLEAR ENERGY

2.- COMBUSTION

2.1.-COMBUSTION MECHANISMS

2.2.- BURNERS

3.- COGENERATION

3.1.-ADVANTAGES AND DISADVANTAGES

3.2.-ENERGY SAVING

3.3.-THERMODYNAMICS: VAPOR TURBINS, GAS, COMBINED CYCLES, ALTERNATIVE MOTORS

4.- TURBINES AND HEAT ENGINES

4.1.-BASIC CYCLE STEAM TURBINES

–Introduction

–Carnot cycle with steam vapor

–Rankine cycle with steam vapor

–Improvement on the Rankine cycle

–Energetic balance in a real cycle

4.2.-BASIC CICLE OF GAS TURBINES

–Introduction

–Ideal Brayton cycle

–Real Brayton cycle

4.3.-ENERGY LOSSES, EFFICIENCY AND POWER OF TURBINES AND THERMAL ENGINES

–Introduction

–Internal losses

–External losses

–Energy efficiency

5.- REFRIGERATION

5.1.-COMPRESSION SYSTEMS

5.2.-ABSORPTION SYSTEMS

Methodology

An inductive methodology of teaching-and learning which combines Inquiry Based Learning with flipped classroom and scientific method is used in this subject.

Students complet flipped learning activities before classes. There is one activity for each chapter.

Sessions are divided in:

- **Lectures:** flipped learning questions resolution and exposition of contents.
- **Collaborative work and visits**: Hands on sessions where students are part active of their formative process students will work individually or in groups.
- **Teamwork project:** Work focused on conventional energies. Written manuscript and oral exposition.
- **Problem solving:** In problem solving sessions teachers present a complex issue that students should solve.

Development plan

Week	Methodology	Topic	Lecture hours	Autonomous Work hours
1	Lecture	Presentation and introduction	2	2
1-2	Flipped learning Collaborative work	Chapter 1. Conventional energies Chapter 2. Combustion	6	10
3-4	Flipped learning Collaborative work	Chapter 3. Cogeneration	8	11
5-8	Flipped learning Collaborative work	Chapter 4. Power cycles	16	24
9		Evaluation. Written test.		
10-15	Flipped learning Collaborative work	Chapter 5. Cooling	18	28
16-19		Evaluation. Written test. Recovery		

Evaluation

CONTINUOUS EVALUATION

EVALUATION BLOCK 1 (30%): FIRST PARTIAL EXAM (individual activity)

- EVALUATION ACTIVITY 1:

-WEIGHT IN THE FINAL GRADE: 30%

-MINIMUM GRADE NECESSARY TO PASS THE SUBJECT: 3

EVALUATION BLOCK 2 (30%): SECOND PARTIAL EXAM (individual activity)

- EVALUATION ACTIVITY 2:

- WEIGHT IN THE FINAL GRADE: 30%

- MINIMUM GRADE NECESSARY TO PASS THE SUBJECT: 3

EVALUATION BLOCK 3 (20%): FLIPPED LEARNING AND IN-CLASS ACTIVITIES

-EVALUATION ACTIVITY 3: FLIPPED LEARNING ACTIVITIES

-WEIGHT IN THE FINAL GRADE: 10%

-EVALUATION ACTIVITY 4: LAB AND IN-CLASS ACTIVITIES

-WEIGHT IN THE FINAL GRADE: 10%

EVALUATION BLOCK 4 (20%): RENEWABLE ENERGIES PROJECT.

-EVALUATION ACTIVITY 5:

-WEIGHT IN THE FINAL GRADE: 20%

There will be recovery only of the 2 individual written exams. In order to make the average at the end of the course, the mark in the partial exams must be >= 3,0 points.

In the event that the student does not achieve the minimum necessary qualification established in some of the evaluation blocks but the average for the subject is approved, the subject will be graded in the evaluation report with a 4,9.

ALTERNATIVE EVALUATION

Students who opt for the alternative assessment must carry out the following activities:

EVALUATION BLOCK 1 (40%): FIRST PARTIAL EXAM (individual activity)

- EVALUATION ACTIVITY 1:

-WEIGHT IN THE FINAL GRADE: 40%

-MINIMUM GRADE NECESSARY TO PASS THE SUBJECT: 3

EVALUATION BLOCK 2 (40%): SECOND PARTIAL EXAM (individual activity)

- EVALUATION ACTIVITY 2:

- WEIGHT IN THE FINAL GRADE: 40%

- MINIMUM GRADE NECESSARY TO PASS THE SUBJECT: 3

EVALUATION BLOCK 3 (20%): RENEWABLE ENERGIES PROJECT.

-EVALUATION ACTIVITY 3:

-WEIGHT IN THE FINAL GRADE: 20%

There will be recovery only of the 2 individual written exams. In order to make the average at the end of the course, the mark in the partial exams must be >= 3,0 points.

In the event that the student does not achieve the minimum necessary qualification established in some of the evaluation blocks but the average for the subject is approved, the subject will be graded in the evaluation report with a 4,9.

Bibliography

- José. Ma. Sala Lizarraga. “Cogeneración. Aspectos termodinámicos, tecnológicos y económicos”, Ed. Servicio Editorial Universidad País Vasco, 1994. ISBN: 84-7585-571-7.
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- Robert.F. Boehm, ‘Developments in the Design of Thermal Systems’, 1997, Ed. Cambridge University Press. ISBN: 0-521-46204-5.
- Claudio Mataix, ‘Turbomáquinas térmicas’, 2000, Ed. Dossat. ISBN: 84-237-0727-X
- Yunus. A. Çengel, M. A. Boles, “Thermodynamics”, McGrawHill, 2002. ISBN: 0-07-112177-3.
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- Aubrey Zalewski "Renewable Energy vs Nonrenewable Energy", 2021, ISBN:9781503844421
- Dimitry Kurochin, Elena V Shabliy, Ekundayo Shittu. "Renewable Energy. International Perspectives on Sustainability", 2020, Palgrave Mcmillan, ISBN: 978-3-030-14207-0