Universitat de Lleida

DEGREE CURRICULUM

ENERGY FACILITIES III

Coordination: MEDRANO MARTORELL, MARCO

Academic year 2019-20

Subject's general information

<table>
<tr><td>Subject name</td><td>ENERGY FACILITIES III</td></tr>
<tr><td>Code</td><td>102313</td></tr>
<tr><td>Semester</td><td>2nd Q(SEMESTER) CONTINUED EVALUATION</td></tr>
<tr><td>Typology</td><td>
<table>
<tr><th>Degree</th><th>Course</th><th>Character</th><th>Modality</th></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>MEDRANO MARTORELL, MARCO</td></tr>
<tr><td>Department</td><td>COMPUTER SCIENCE AND INDUSTRIAL ENGINEERING</td></tr>
<tr><td>Teaching load distribution between lectures and independent student work</td><td>60 h of lectures (40%)
90 h independent student work (60%)</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. Marc Medrano Martorell 5,2 ECTS
Josep Eras Vila 2 ECTS</td></tr>
<tr><td>Office and hour of attention</td><td>To be specified the first day of class.</td></tr>
</table>

Teaching staff	E-mail addresses	Credits taught by teacher	Office and hour of attention
ERAS VILA, JOSEP ANTONI	josep.eras@udl.cat	2	
MEDRANO MARTORELL, MARCO	marc.medrano@udl.cat	5,2	

Subject's extra information

This course requires continuous work throughout the semester in order to achieve the established goals. It is recommended to visit frequently the Virtual Campus subject, because it announces all the information in it. This subject belongs to the module "Optatisysve Subjects", specifically in the field "Services". We recommend using direct mail instead of the Messaging options via the Virtual Campus. There are no prerequisites for this course, but a basic knowledge of thermodynamic power cycles and heat transfer are recommended.
The flippled classroom methodology is used in this subject to facilitate the work of problems, project and difficult concepts in class.

It is **COMPULSORY** that the students bring the following elements of individual protection (EPI) to the practices at the laboratory.

- Blue or white laboratory gown from UdL (unisex)
- Protection glasses
- Mechanical protection gloves

They can be purchased through the shop Údels of the UdL:

C/ Jaume II, 67 baixos
Centre the Cultures i Cooperació Transfronterera

http://www.publicacions.udl.cat/

The use of other elements of protection (for example caps, masks, gloves of chemical or electrical risk, etc.) will depend on the type of practice to be done. In that case, the teacher will inform of the necessity of specific EPI.

Not bringing the EPI's described or not fulfilling the norms of general security that are detailed below imply that the student can not access to the laboratories or have to go out of them. The no realisation of the practices for this reason imply the **consequences in the evaluation** of the subject that are described in this course guide.

GENERAL NORMS OF SECURITY IN LABORATORY PRACTICES

- Keep the place of realisation of the practices clean and tidy. The table of work has to be free from backpacks, folders, coats...
- No short trousers or short skirts are allowed in the laboratory.
- Closed and covered footwear is compulsory in the laboratory.
- Long hair needs to be tied.
- Keep the laboratoy gown laced in order to be protected from spills of chemicals.

- Bangles, pendants or wide sleeves are not allowed as they can be trapped.
- Avoid the use of contact lenses, since the effect of the chemical products is much bigger if they enter between the contact lense and the cornea. Protection over-glasses can be purchased.
- No food or drink is allowed in the laboratory.
- It is forbidden to smoke in the laboratories.
- Wash your hands whenever you have contact with a chemical product and before going out of the laboratory.
- Follow the instructions of the teacher and of the laboratory technicians and ask for any doubt on security.

For further information, you can check the following document of the *Servei de Prevenció de Riscos Laborals de la UdL*: http://www.sprl.udl.cat/alumnes/index.html

Learning objectives

- To be able to search, understand and synthesize information in a foreign language.
- To provide students with the basic knowledge to analyse energy systems from different points of view, energy, the economic and exergetic.
- To introduce students to energy systems for capturing solar radiation.
- To understand in detail a power plant with renewable energy.
- To strengthen the previous study using the flipped classroom methodology.
- To understand in practice the elements and operation of an installation of solar thermal collectors of low temperature.

Competences

University of Lleida strategic competences

- **UdL2** Command of a foreign language..

Cross-disciplinary competences

- **EPS4**. To have the skills required to undertake new studies or improve the training with self-direction.
- **EPS9**. Capacity for unidisciplinary and multidisciplinary teamwork.

Specific competences

- **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. Introduction

1.1 Energy situation in Catalonia, Spain and worldwide

1.2 Impact of CO_2 emissions and emissions rights

1.3 Sequestering of CO_2

2. Energy analysis

2.1 Mass balances with no chemical reaction

2.2 Mass balance with chemical reaction

2.3 Energy analysis of cogeneration plant

3. Exergy analysis

3.1 Introduction to exergy concept

3.2 Exergy components

3.3 Exergy analysis of cogeneration plant

4. Economic Analysis

4.1 Investment estimates

4.2 Profitability indicators

5. Solar thermal installations

5.1 Solar radiation

5.2 Solar thermal energy

Methodology

The methodological axes of the course will be divided into:

1. Lectures where the professor will review the answers that students have given after performing the previous work before each chapter (Flipped classroom) and will work in classe those concepts that have been more difficult to understand and calculation procedures necessary for the comprehensive project and for addressing properly the problems of each chapter.

2.-Practical sessions where students will be central part of the training process, focused on the development of an integral project.

Development plan

The development plan will follow the order of the contents.

Week	Methodology	Topic	Lecture Hours	Autonomous work hours
1	Lecture	Subject presentation, Intro to EES.	4	6
2	Lecture	1. Introduction	2	3
2-5	Lecture. Resolution of problems	2. Energy analysis and project practical sessions .	12	18
5	Visita	Visit to Borges thermal power plant	2	3

6-8	Lecture. Resolution of problems	3. Exergy analysis and project practical sessions .	12	18
9		Evaluation. Written test.		
10-12	Lecture. Resolution of problems	4. Economic analysis and project practical sessions .	10	15
12-15	Lecture. Resolution of problems. Lab practice.	5. Solar thermal installations and and project practical sessions. Solar collectors lab practice.	12	18
15	Oral presentations	Project oral presentations	2	3
16-19		Evaluation. Written Test. Recovery		

Evaluation

ACTIVITY OF EVALUATION 1: FIRST PARTIAL (individual, written)

- 15%

- Grade ≥ 3

ACTIVITY OF EVALUATION 2: PRESENTATION PROJECT (individual, oral)

- 25%

ACTIVITY OF EVALUATION 3: REPORT PROJECT (written, group)

- 25%

- Group activity

ACTIVITY OF EVALUATION 4: SECOND PARTIAL (individual, written)

- 15%

- Grade ≥ 3

ACTIVTY OF EVALUATION 5: FOLLOW UP OF SUBJECT VIA FLIPPED LEARNING

- 15% (5% OPEN QUESTIONS, 10% MULTIPLE CHOICE TESTS)

ACTIVTY OF EVALUATION 6: SOLAR COLLECTORS LAB PRACTICE

- 5%

Bibliography

References

- Bejan, 'Thermal Design Optimization', 1996. Ed. John Wiley & Sons, Inc. ISBN: 0-471-58467-3
- R.F. Boehm, 'Developments in the Design of Thermal Systems', 1997, Ed. Cambridge University Press. ISBN: 0-521-46204-5
- T.J. Kotas, 'The Exergy Method of Thermal Plant Analysis', 1985, Ed. Butterworth. ISBN: 0-408-01350-8
- Y. Jaluria, 'design and Optimization of Thermal Systems', 1998
- G.V.Reklaitis, 'Balances de Materia y Energía', 1986, Nueva Editorial Interamericana. ISBN: 968-25-1146-1
- J.F. Ahern, 'The Exergy Method of Energy Systems Analysis', 1980, Ed. John Wiley & Sons, Inc.
- E.Buatas Costa, 'Manual de Conservación de la Energía', Ed. Gestión y Planificación Integral, S.A. ISBN: 8-485-82700-7
- L. Cabeza, M. Medrano, I. Martorell, 'Gestió de sistemes energètics – Fred i calor industrial –', Quaderns EPS
- L. Cabeza, I. Martorell, 'Producció de l'energia tèrmica – Fred i calor industrial –', Quaderns EPS - Núm. 93.