



Universitat de Lleida

## DEGREE CURRICULUM **SERVICES III**

Coordination: MEDRANO MARTORELL, MARCO

Academic year 2016-17

## Subject's general information

<b>Subject name</b>	SERVICES III			
<b>Code</b>	102313			
<b>Semester</b>	2nd Q(SEMESTER) CONTINUED EVALUATION			
<b>Typology</b>	Degree	Course	Typology	Modality
	Bachelor's Degree in Mechanical Engineering	4	OPTIONAL	Attendance-based
<b>ECTS credits</b>	6			
<b>Groups</b>	1GG			
<b>Theoretical credits</b>	2			
<b>Practical credits</b>	4			
<b>Coordination</b>	MEDRANO MARTORELL, MARCO			
<b>Department</b>	INFORMATICA I ENGINYERIA INDUSTRIAL			
<b>Teaching load distribution between lectures and independent student work</b>	60 h of lectures (40%) 90 h independent student work (60%)			
<b>Important information on data processing</b>	Consult <a href="#">this link</a> for more information.			
<b>Language</b>	English. The student can answer the assessment tests in English, Spanish or Catalan.			
<b>Distribution of credits</b>	Dr. Marc Medrano Martorell 3,6 ECTS Josep Eras Vila 2,4 ECTS			
<b>Office and hour of attention</b>	To be specified the first day of class.			

Professor/a (s/es)	Adreça electrònica professor/a (s/es)	Crèdits	Horari de tutoria/lloc
ERAS VILA, JOSEP ANTONI	jeras@diei.udl.cat	2,5	
MEDRANO MARTORELL, MARCO	mmedrano@diei.udl.cat	4,7	

## 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 flipped classroom methodology is used in this subject to facilitate the work of problems, project and difficult concepts in class.

## 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<sub>2</sub> emissions and emissions rights

1.3 Sequestering of CO<sub>2</sub>

## 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.

## 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  $\geq 3$

### 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  $\geq 3$

## **ACTIVITY OF EVALUATION 5: FOLLOW UP OF SUBJECT VIA FLIPPED LEARNING**

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

## **ACTIVITY 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.