Universitat de Lleida

DEGREE CURRICULUM

SERVICES II

Coordination: MARTORELL BOADA, INGRID

Academic year 2017-18

ENERGY FACILITIES II 2017-18

Subject's general information

Subject name	SERVICES II
Code	102312
Semester	2nd Q(SEMESTER) CONTINUED EVALUATION
Typology	<table><tr><th>Degree</th><th>Course</th><th>Typology</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></table>
ECTS credits	6
Groups	1GG
Theoretical credits	3
Practical credits	3
Coordination	MARTORELL BOADA, INGRID
Department	INFORMATICA I ENGINYERIA INDUSTRIAL
Teaching load distribution between lectures and independent student work	60 h lectures (40%) 90 h autonomous (60%)
Important information on data processing	Consult this link for more information.
Language	English
Distribution of credits	Dr Ingrid Martorell
Office and hour of attention	To contact the teacher to set up an appointment

ENERGY FACILITIES II 2017-18

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

Subject's extra information

Facilities II is an optional second semester course in Mechanical Engineering Degree and 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

UdL competences

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

Transversal 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 of them and reduction of the environmental burden.

Subject contents

1.- COMBUSTION

1.1.-COMBUSTION MECHANISMS

1.2.- BURNERS

2.- REFRIGERATION

- 2.1.-COMPRESSION SYSTEMS
- 2.2.-ABSORPTION SYSTEMS

3.-CONVENTIONAL ENERGIES

- 3.1.-FOSSIL FUELS
- 3.2.-NATURAL GAS
- 3.3.-OIL
- 3.4.-NUCLEAR ENERGY

4.- COGENERATION

- 4.1.-ADVANTAGES AND DISADVANTAGES
- 4.2.-ENERGY SAVING
- 4.3.-THERMODYNAMICS: VAPOR TURBINS, GAS, COMBINED CYCLES, ALTERNATIVE MOTORS

5.- TURBINES AND HEAT ENGINES

- 5.1.-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
- 5.2.-BASIC CICLE OF GAS TURBINES
  - –Introduction
  - –Ideal Brayton cycle
  - –Real Brayton cycle
- 5.3.-ENERGY LOSSES, EFFICIENCY AND POWER OF TURBINES AND THERMAL ENGINES
  - –Introduction
  - –Internal losses
  - –External losses
  - –Energy efficiency

Methodology

The activities will be divided into three parts that complement each other: lectures, visits and seminars and problem solving.

- **Lectures:** In the lectures expose the contents of the subject orally by the teacher without the active participation of students.

- **Visits and seminars**: Practial sessions where students will play an active role: individual or in-group activities.
- **Problem solving:** In problem solving sessions teachers present a complex issue that students should solve, whether working individually or in teams .
- **Lab activity:** Practical sessions in small groups in the laboratory

Development plan

Week	Methodology	Topic	Lecture hours	Autonomous Work hours
1	Lecture	Presentation and introduction	2	3
1-2	Lecture Problems solving	Chapter 1. Combustion	6	9
3-7	Lecture Lab activity Problems solving	Tema 2. Refrigeration	18	27
5	Visit	Thermosolar plant Borges	2	3
8	Lecture Problems solving	Tema 3. Conventional Energies	4	6
9		Evaluation. Written test.		
10-11	Lecture Problems solving	Tema 4. Cogeneration	8	12
12-15	Lecture Problems solving	Tema 5. Turbines and motors	16	24
16-19		Evaluation. Written test. Recovery		

Evaluation

• EVALUATION ACTIVITY 1: PARTIAL EXAM 1: Practical examination of the contents worked from week 1 to 8. This activity contributes 35% of the total mark of the subject; Minimum score to be considered for final grade >= 3.0 points.
• EVALUATION ACTIVITY 2: PARTIAL EXAM 2: Practical examination of the contents worked from week 10 until the end of the course. This activity contributes 35% of the total mark of the subject; Minimum score to be considered for final grade >= 3.0 points.
• EVALUATION ACTIVITY 3: Individual test about the contents of a scientific paper in English. This test contributes 15% of the total mark of the subject; Minimum score to be considered for final grade >= 4.0 points.
• EVALUATION ACTIVITY 4: Delivery in groups of a report of lab activities as well as in-class activities. These

tests contribute 15% of the total mark of the subject; Minimum score to be considered for final grade >= 4.0 points.

The final score will be configured with the arithmetic sum of the marks obtained in the aforementioned activities. The subject will be passed if the note is a value greater than or equal to 5. There will be recoveries of evaluation activiies 1 and 2.

Bibliography

Basic bibliography

- Generación de vapor", Centro de Estudios de la Energía, 1983. ISBN: 8450092930
- J. M. Sala Lizarraga. "Cogeneración. Aspectos termodinámicos, tecnológicos y económicos", Ed. Servicio Editorial Universidad País Vasco, 1994. ISBN: 84-7585-571-7.
- 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.
- C. Mataix, 'Turbomáquinas térmicas', 2000, Ed. Dossat. ISBN: 84-237-0727-X
- Y. A. Çengel, M. A. Boles, "Thermodynamics", McGrawHill, 2002. ISBN: 0-07-112177-3.

Complementary bibliography

- Curso de vapor, Spirax Sarco.
- C. D. Shield. "Calderas. Tipos, características sus funciones", Ed. CECSA, 1973.
- J. A. Orlando. "Cogeneration design guide", ASHRAE, 1996. ISBN: 1-883413-36-2.
- J. M. Pinazo, "Manual de climatización", 1995, Servicio de Publicaciones Universidad Politécnica de Valencia. ISBN: 84-7721-339-9.
- E. Carnicer Royo, "Aire acondicionado", 2002, Ed. Paraninfo. ISBN: 84-283-2048-9.
- M. Ortega, A. Ortega, "Calefacción y refrescamiento por superficies radiantes", 2000, Ed. Paraninfo. ISBN: 84-283-2741-6.