Course guide
240605 - 240605 - Electric Mobility

Unit in charge: Barcelona School of Industrial Engineering
Teaching unit: 709 - DEE - Department of Electrical Engineering.
Degree: BACHELOR'S DEGREE IN INDUSTRIAL TECHNOLOGY ENGINEERING (Syllabus 2010). (Optional subject).
Academic year: 2022 ECTS Credits: 4.5 Languages: English

LECTURER

Coordinating lecturer: DANIEL MONTESINOS MIRACLE

Others:

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
3. Capacity to solve mathematical problems that can appear in engineering. Aptitude to apply knowledge about: linear algebra; geometry; differential geometry; differential and integral calculus; differential equations and derived partial equations; numerical methods; numerical algorithm; statistics and optimisation.
4. Understanding and dominion of basic concepts on mechanics, thermodynamics, fields and waves and electromagnetism laws and their application to solve engineering problems.
5. Knowledge and use of electric machines and circuit theory principles.
6. Knowledge and use of machines and mechanisms theory principles.
7. Basic knowledge on the use and programming of computers, operative systems, data bases and computer software with an engineering application.
8. Knowledge on machines control and electrical drives and their applications.

Transversal:
1. EFFICIENT ORAL AND WRITTEN COMMUNICATION. Communicating verbally and in writing about learning outcomes, thought-building and decision-making. Taking part in debates about issues related to the own field of specialization.
2. TEAMWORK. Being able to work as a team player, either as a member or as a leader. Contributing to projects pragmatically and responsibly, by reaching commitments in accordance to the resources that are available.

TEACHING METHODOLOGY

S'imparteixen classes de teoria i de laboratori basades en un aprenentatge cooperatiu

LEARNING OBJECTIVES OF THE SUBJECT

The objective of the course is to provide students with a general vision of the main aspects of electric mobility.
Describe the present situation of electrical mobility.
Energetic evaluation of a vehicle. Allow the possibility to make an energetic balance of a given vehicle and specify the rated values for the drivetrain.
Describe all the elements in the traction chain: battery, converter and motor.
Identify possible alternatives and main components and working principles for each of them.
STUDY LOAD

<table>
<thead>
<tr>
<th>Type</th>
<th>Hours</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hours large group</td>
<td>45,0</td>
<td>40.00</td>
</tr>
<tr>
<td>Self study</td>
<td>67,5</td>
<td>60.00</td>
</tr>
</tbody>
</table>

**Total learning time:** 112.5 h

CONTENTS

(ENG) Tema 1 Introducció a la mobilitat elèctrica

**Description:**
(ENG) Define what electric mobility is. Brief historical review of electric mobility. Define the components and topologies of electric and hybrid vehicles. Define the needs of a vehicle’s traction system. Evaluate the energy chain and the impact of electric vehicles. Electric vehicle charging infrastructure. Railway system

**Related competencies:**
CE1. Capacity to solve mathematical problems that can appear in engineering. Aptitude to apply knowledge about: linear algebra; geometry; differential geometry; differential and integral calculus; differential equations and derived partial equations; numerical methods; numerical algorithm; statistics and optimisation.
CE2. Understanding and dominion of basic concepts on mechanics, thermodynamics, fields and waves and electromagnetism laws and their application to solve engineering problems.

**Full-or-part-time:** 15h 50m
Theory classes: 9h
Self study : 6h 50m

(ENG) Tema 2 Dinàmica del vehicle i avaluació energètica

**Description:**
(ENG) Analyze the mechanical dynamics of a vehicle in order to assess its energy needs and be able to specify the traction chain

**Related competencies:**
CE1. Capacity to solve mathematical problems that can appear in engineering. Aptitude to apply knowledge about: linear algebra; geometry; differential geometry; differential and integral calculus; differential equations and derived partial equations; numerical methods; numerical algorithm; statistics and optimisation.
CE2. Understanding and dominion of basic concepts on mechanics, thermodynamics, fields and waves and electromagnetism laws and their application to solve engineering problems.
CE14. Knowledge and use of machines and mechanisms theory principles.
CE3. Basic knowledge on the use and programming of computers, operative systems, data bases and computer software with an engineering application.

**05 TEQ. TEAMWORK.** Being able to work as a team player, either as a member or as a leader. Contributing to projects pragmatically and responsibly, by reaching commitments in accordance to the resources that are available.

**04 COE. EFFICIENT ORAL AND WRITTEN COMMUNICATION.** Communicating verbally and in writing about learning outcomes, thought-building and decision-making. Taking part in debates about issues related to the own field of specialization.

**Full-or-part-time:** 18h 20m
Theory classes: 3h
Laboratory classes: 3h
Self study : 12h 20m
**Tema 3: Emmagatzematge d'energia en vehicles**

**Description:**
(ENG) Know the different energy storage technologies in electric vehicles

**Related competencies:**
CE1. Capacity to solve mathematical problems that can appear in engineering. Aptitude to apply knowledge about: linear algebra; geometry; differential geometry; differential and integral calculus; differential equations and derived partial equations; numerical methods; numerical algorithm; statistics and optimisation.
CE2. Understanding and dominion of basic concepts on mechanics, thermodynamics, fields and waves and electromagnetism laws and their application to solve engineering problems.
CE10. Knowledge and use of electric machines and circuit theory principles.
CE3. Basic knowledge on the use and programming of computers, operative systems, data bases and computer software with an engineering application.

05 TEQ. TEAMWORK. Being able to work as a team player, either as a member or as a leader. Contributing to projects pragmatically and responsibly, by reaching commitments in accordance to the resources that are available.

04 COE. EFFICIENT ORAL AND WRITTEN COMMUNICATION. Communicating verbally and in writing about learning outcomes, thought-building and decision-making. Taking part in debates about issues related to the own field of specialization.

**Full-or-part-time:** 18h 20m
- Theory classes: 3h
- Laboratory classes: 3h
- Self study: 12h 20m

**Tema 4: Tracció elèctrica**

**Description:**
(ENG) Know and analyze the elements in the traction chain of electric vehicles: motors and converters. Design the necessary drivers for the traction chain. Torque and speed control.

**Related competencies:**
CE1. Capacity to solve mathematical problems that can appear in engineering. Aptitude to apply knowledge about: linear algebra; geometry; differential geometry; differential and integral calculus; differential equations and derived partial equations; numerical methods; numerical algorithm; statistics and optimisation.
CE2. Understanding and dominion of basic concepts on mechanics, thermodynamics, fields and waves and electromagnetism laws and their application to solve engineering problems.
CE10. Knowledge and use of electric machines and circuit theory principles.
CE3. Basic knowledge on the use and programming of computers, operative systems, data bases and computer software with an engineering application.

05 TEQ. TEAMWORK. Being able to work as a team player, either as a member or as a leader. Contributing to projects pragmatically and responsibly, by reaching commitments in accordance to the resources that are available.

04 COE. EFFICIENT ORAL AND WRITTEN COMMUNICATION. Communicating verbally and in writing about learning outcomes, thought-building and decision-making. Taking part in debates about issues related to the own field of specialization.

**Full-or-part-time:** 60h
- Theory classes: 15h
- Laboratory classes: 9h
- Self study: 36h
**ACTIVITIES**

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**(ENG) LABORATORI DE DINÀMICA DEL VEHICLE**

**Related competencies:**

CE1. Capacity to solve mathematical problems that can appear in engineering. Aptitude to apply knowledge about: linear algebra; geometry; differential geometry; differential and integral calculus; differential equations and derived partial equations; numerical methods; numerical algorithm; statistics and optimisation.

CE2. Understanding and dominion of basic concepts on mechanics, thermodynamics, fields and waves and electromagnetism laws and their application to solve engineering problems.

CE14. Knowledge and use of machines and mechanisms theory principles.

05 TEQ. TEAMWORK. Being able to work as a team player, either as a member or as a leader. Contributing to projects pragmatically and responsibly, by reaching commitments in accordance to the resources that are available.

04 COE. EFFICIENT ORAL AND WRITTEN COMMUNICATION. Communicating verbally and in writing about learning outcomes, thought-building and decision-making. Taking part in debates about issues related to the own field of specialization.

**Full-or-part-time:** 18h 20m

- Theory classes: 3h
- Laboratory classes: 3h
- Self study: 12h 20m

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**(ENG) LABORATORI DE BATERIES**

**Related competencies:**

CE1. Capacity to solve mathematical problems that can appear in engineering. Aptitude to apply knowledge about: linear algebra; geometry; differential geometry; differential and integral calculus; differential equations and derived partial equations; numerical methods; numerical algorithm; statistics and optimisation.

CE2. Understanding and dominion of basic concepts on mechanics, thermodynamics, fields and waves and electromagnetism laws and their application to solve engineering problems.

CE10. Knowledge and use of electric machines and circuit theory principles.

05 TEQ. TEAMWORK. Being able to work as a team player, either as a member or as a leader. Contributing to projects pragmatically and responsibly, by reaching commitments in accordance to the resources that are available.

04 COE. EFFICIENT ORAL AND WRITTEN COMMUNICATION. Communicating verbally and in writing about learning outcomes, thought-building and decision-making. Taking part in debates about issues related to the own field of specialization.

**Full-or-part-time:** 18h 20m

- Theory classes: 3h
- Laboratory classes: 3h
- Self study: 12h 20m
(ENG) LABORATORI DE TRACCO

Related competencies:

CE1. Capacity to solve mathematical problems that can appear in engineering. Aptitude to apply knowledge about: linear algebra; geometry; differential geometry; differential and integral calculus; differential equations and derived partial equations; numerical methods; numerical algorithm; statistics and optimisation.

CE2. Understanding and dominion of basic concepts on mechanics, thermodynamics, fields and waves and electromagnetism laws and their application to solve engineering problems.

CE10. Knowledge and use of electric machines and circuit theory principles.

CE14. Knowledge and use of machines and mechanisms theory principles.

CETI8B. Knowledge on machines control and electrical drives and their applications.

05 TEQ. TEAMWORK. Being able to work as a team player, either as a member or as a leader. Contributing to projects pragmatically and responsibly, by reaching commitments in accordance to the resources that are available.

04 COE. EFFICIENT ORAL AND WRITTEN COMMUNICATION. Communicating verbally and in writing about learning outcomes, thought-building and decision-making. Taking part in debates about issues related to the own field of specialization.

Full-or-part-time: 60h
Theory classes: 15h
Laboratory classes: 9h
Self study: 36h

GRADING SYSTEM

L’avaluació es fa mitjançant un examen final (Nef) i l’avaluació d’un treball realitzat tant a les sessions de laboratori com a casa (Nlab).

\[ N_f = 0.4 \times N_{ef} + 0.6 \times N_{lab} \]

Durant el quadrimestre de primavera del curs 2019-2020, i com a conseqüència de la crisi sanitària per causa de la Covid19, el mètode de qualificació serà:

\[ N_f = N_{lab} \]

EXAMINATION RULES.

Per l’examen final no es poden dur apunts.

BIBLIOGRAPHY

Basic:

Complementary:
978-1-84919-071-8.