



## Course guide

### 240605 - 240605 - Electric Mobility

**Last modified:** 16/05/2023

**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:** 2023    **ECTS Credits:** 4.5    **Languages:** English

#### LECTURER

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**Coordinating lecturer:** DANIEL MONTESINOS MIRACLE

**Others:**

#### DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

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##### 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

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

#### LEARNING OBJECTIVES OF THE SUBJECT

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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

Type	Hours	Percentage
Hours large group	45,0	40.00
Self study	67,5	60.00

**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 :**

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

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.

**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 :**

CE3. Basic knowledge on the use and programming of computers, operative systems, data bases and computer software with an engineering application.

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

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

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.

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.

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.

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

Theory classes: 3h

Laboratory classes: 3h

Self study : 12h 20m



### (ENG) Tema 3 Emmagatzematge d'energia en vehicles

**Description:**

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

**Related competencies :**

CE3. Basic knowledge on the use and programming of computers, operative systems, data bases and computer software with an engineering application.

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

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

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.

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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.

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

Theory classes: 3h

Laboratory classes: 3h

Self study : 12h 20m

### (ENG) 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 :**

CE3. Basic knowledge on the use and programming of computers, operative systems, data bases and computer software with an engineering application.

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

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

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.

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.

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.

**Full-or-part-time:** 60h

Theory classes: 15h

Laboratory classes: 9h

Self study : 36h

## ACTIVITIES

### (ENG) LABORATORI DE DINÀMICA DEL VEHICLE

#### Related competencies :

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

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

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.

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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.

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

Theory classes: 3h

Laboratory classes: 3h

Self study: 12h 20m

### (ENG) LABORATORI DE BATERIES

#### Related competencies :

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

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

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.

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.

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.

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

Theory classes: 3h

Laboratory classes: 3h

Self study: 12h 20m



## (ENG) LABORATORI DE TRACCIO

### Related competencies :

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

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

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

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

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.

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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.

### 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).

$$Nf=0,4*Nef+0,6*Nlab$$

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:

$$Nf=Nlab$$

## EXAMINATION RULES.

Per l'examen final no es poden dur apunts.

## BIBLIOGRAPHY

### Basic:

- Ehsani, Mehrdad; Gao, Yimin; Emadi, Ali. Modern electric, hybrid electric, and fuel cell vehicles : fundamentals, theory, and design. 2nd ed. Boca Raton: CRC Press, cop. 2010. ISBN 978-1-4200-5398-2.

- Miller, J. M. Propulsion systems for hybrid vehicles [on line]. 2nd ed. Stevenage, UK: Institution of Engineering and Technology, 2010 [ Consultation: 24/03/2023 ]. Available on: <https://ebookcentral-proquest-com.recursos.biblioteca.upc.edu/lib/upcatalunya-ebooks/detail.action?pq-origsite=primo&docID=774057>. ISBN 9781849191470.

- Husain, Iqbal. Electric and hybrid vehicles : design fundamentals. 2nd ed. Boca Raton: CRC Press, 2010. ISBN 9781439811757.

- Barrade, Philippe. Électronique de puissance : méthodologie et convertisseurs élémentaires. Lausanne: Presses polytechniques et universitaires romandes, cop. 2006. ISBN 2-88074-566-7.

- Mohan, Ned; Undeland, Tore M; Robbins, William P. Power electronics : converters, applications, and design. 3rd ed. New York: Wiley, 2003. ISBN 0471226939.

- Buso, Simone; Mattavelli, Paolo. Digital control in power electronics. San Rafael, CA: Morgan & Claypool Publishers, cop. 2006. ISBN 1598291122.

### Complementary:

- Miller, John M. Ultracapacitor applications [on line]. Stevenage: Institution of Engineering and Technology, 2011 [Consultation: 07/10/2020]. Available on: <https://ebookcentral-proquest-com/lib/upcatalunya-ebooks/detail.action?docID=827220>. ISBN

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