Last update: 23-04-2019

320169 - VE - Electric Vehicles

Coordinating unit: 205 - ESEIAAT - Terrassa School of Industrial, Aerospace and Audiovisual Engineering
Teaching unit: 709 - EE - Department of Electrical Engineering
Academic year: 2019
Degree: BACHELOR'S DEGREE IN ELECTRICAL ENGINEERING (Syllabus 2009). (Teaching unit Optional)
ECTS credits: 6 Teaching languages: English

Teaching staff

Coordinator: Joan Montañá Puig

Others: David Romero Duran, Luis Martínez Barrios,

Degree competences to which the subject contributes

Transversal:

1. SELF-DIRECTED LEARNING - Level 2: Completing set tasks based on the guidelines set by lecturers. Devoting the time needed to complete each task, including personal contributions and expanding on the recommended information sources.
2. SUSTAINABILITY AND SOCIAL COMMITMENT - Level 2. Applying sustainability criteria and professional codes of conduct in the design and assessment of technological solutions.
3. TEAMWORK - Level 2. Contributing to the consolidation of a team by planning targets and working efficiently to favor communication, task assignment and cohesion.

Teaching methodology

1. Theoretical sessions: the professor introduces the theoretical foundations of the subject, concepts, methods, illustrating them with examples to facilitate understanding.
2. Practical work sessions: The sessions of practical work in the classroom and the laboratory.
3. Independent work and study exercises: Students will have to work and study individually and independently in order to assimilate the concepts, solving exercises.

Learning objectives of the subject

Topic 1 Introduction to the subject
Topic 2. Basics of transport: basic knowledge of mechanical transmission of power. There will be emphasis on adherence, layout and aerodynamics.
Topic 3. Motors for electric traction: This topic describes the specific application of electric motors in vehicles.
Topic 4. Energy storage: An important part of electric vehicles is the energy storage.
Topic 5. Electric Vehicle (EV): Student will learn the components of electric vehicles and functions.
Topic 6. Rail traction: One of the classic applications of electric traction is the railway. We will present different modes of traction in trains carrying special emphasis on high speed.

Last update: 23-04-2019

320169 - VE - Electric Vehicles

Study load

Total learning time: 150h	Hours large group:	30h	20.00%
	Hours medium group:	0h	0.00%
	Hours small group:	30h	20.00%
	Guided activities:	0h	0.00%
	Self study:	90h	60.00%

Last update: 23-04-2019

320169 - VE - Electric Vehicles

Content

TOPIC 1: Introduction

Learning time: 4h

Theory classes: 2h
Self study : 2h

Description:
1.1 Introduction
1.2 History of the electric propulsion and current frame

TOPIC 2: Basic knowledge of transport

Learning time: 18h

Theory classes: 6h
Practical classes: 2h
Self study : 10h

Description:
2.1 Basic concepts of mechanical power transmission: friction and adhesion
2.2 Basics of aerodynamics
2.3 Basics of inertia and track

Related activities:
Activity 1: Issues and case studies in classroom.
Activity 2: Individual test.

TOPIC 3: Motors for electric traction

Learning time: 38h

Theory classes: 6h
Practical classes: 4h
Laboratory classes: 4h
Self study : 24h

Description:
3.1 DC Motors
3.2 Induction Motors
3.3 BLDC Motors
3.4 PMSM Motors
3.5 SRM Motors

Related activities:
Activity 1: Case studies in classroom.
Activity 2: Individual test.
Activity 3: Work in the laboratory.

Last update: 23-04-2019

320169 - VE - Electric Vehicles

TOPIC 4: Energy storage	Learning time: 26h Theory classes: 6h Practical classes: 2h Laboratory classes: 2h Self study : 16h

Description:
4.1 Batteries
4.2 Fuel Cells
4.4 Kinetic Batteries

Related activities:
Activity 1: Issues and case studies in classroom.
Activity 2: Individual test
Activity 3: Work in the laboratory

TOPIC 5: Electric vehicles (EV)	Learning time: 46h Theory classes: 12h Practical classes: 2h Laboratory classes: 6h Self study : 26h

Description:
5.1 EV setting
5.2 EV operation
5.3 Characteristics of traction
5.4 Effort tractor and transmission
5.5 Energy Consumption
5.6 Regenerative Braking
5.7 Hybrid Vehicles

Related activities:
Activity 1: Case studies in classroom.
Activity 2: Individual test.
Activity 3: Practice in the laboratory.

Last update: 23-04-2019

320169 - VE - Electric Vehicles

TOPIC 6: Rail traction	Learning time: 18h Theory classes: 4h Practical classes: 2h Self study : 12h

Description:
6.1 Introduction to propel rail
6.2 Types of machines railway
6.3 Structure of electrified tracks

Related activities:
Activity 1: Case studies in classroom.
Activity 2: Individual test.

Qualification system

- Final test 35%
- Small project: 20%
- Practical work: 45 %

Practical work includes: 40 % experiments on electric vehicle drives; vehicle movement (10 %), vehicle performance (20 %), batteries (10 %), Fuel cells (10 %), visit or others (10 %). It is compulsory to attend the Practical work sessions.

The Final test will be done according to the schedule of the final exams. Unsatisfying results of the Final test could be repeated in a test to be allocated during the period of the final exams. Students with a grade lower than 5 points (unsatisfactory) can retake the test. The new grade, if it is equal or higher than 5 points, will substitute with the Final test grade with 5 points.

320169 - VE - Electric Vehicles

Bibliography

Basic:

Pistoia, Gianfranco. Electric and hybrid vehicles: power sources, models, sustainability, infrastructure and the market [on line]. Elsevier, 2010 [Consultation: 26/09/2012]. Available on: <http://www.sciencedirect.com/science/book/9780444535658>. ISBN 9780444535658.

Ehsani, M.; Gao, Y.; Emadi, A. Modern electric, hybrid electric, and fuel cell vehicles: fundamentals, theory and design. 2nd ed. Boca Raton: CRC Press, 2010. ISBN 9781420053982.

Álvarez Mántaras D.; Luque Rodríguez, P. Ingeniería e infraestructura de los transportes: ferrocarriles. Oviedo: Universidad de Oviedo, 2003. ISBN 8483173654.

Complementary:

Savaresi, Sergio M. Active braking control systems design for vehicles. Springer, 2010. ISBN 9781849963497.

Larrodé, Emilio. Automóviles eléctricos. Reverté, 2011. ISBN 9788414360095.

Westbrook, Michael H. The electric car: development and future of battery, hybrid and fuel-cell cars. Six Hills Way: The Institution of Electrical Engineers, 2001. ISBN 0852960131.

Miller, John M. Propulsion systems for hybrid vehicles. London: The Institution of Electrical Engineers, 2004. ISBN 0863413366.