Course guide
320182 - ACVE - Operation and Control of Electric Vehicles

Last modified: 19/04/2023

Unit in charge: Terrassa School of Industrial, Aerospace and Audiovisual Engineering
Teaching unit: 710 - EEL - Department of Electronic Engineering.

Degree: BACHELOR'S DEGREE IN INDUSTRIAL ELECTRONICS AND AUTOMATIC CONTROL ENGINEERING (Syllabus 2009). (Optional subject).

Academic year: 2023 **ECTS Credits:** 6.0 **Languages:** English

LECTURER

Coordinating lecturer: Luis Romeral

Others: Juan Antonio Ortega

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
1. IND_COMMON: An understanding of and the ability to use the principles of circuit theory and electrical machines.

2. IND_COMMON: Basic electronic knowledge

3. ELO: Knowledge of the foundations and applications of digital electronics and microprocessors

4. ELO: skills for The modelling and simulation of systems.

Transversal:
5. EFFICIENT ORAL AND WRITTEN COMMUNICATION - Level 3. Communicating clearly and efficiently in oral and written presentations. Adapting to audiences and communication aims by using suitable strategies and means.
6. TEAMWORK - Level 3. Managing and making work groups effective. Resolving possible conflicts, valuing working with others, assessing the effectiveness of a team and presenting the final results.
7. SELF-DIRECTED LEARNING - Level 3. Applying the knowledge gained in completing a task according to its relevance and importance. Deciding how to carry out a task, the amount of time to be devoted to it and the most suitable information sources.

TEACHING METHODOLOGY

In the theory sessions, the teacher will introduce the theoretical bases of the subject, trying to emphasize the aspects of application of the contents, linking with the previous and later subjects of the subject, and following a line of argument consistent with the objectives. . of the subject. subject.
The presentation of the concepts and their development must be done in a clear and concise way, illustrating examples in order to facilitate their understanding. The complete documentation will be deposited on the UPC virtual campuses.
Some of these sessions could be presented by technicians from the industrial world, coordinated and directed by the professor of the subject.
In the practical laboratory and simulation sessions, students should be able to review the accumulated concepts covered in the theory and application sessions. Given the great practical load of the subject, it is intended to highlight especially the use and application of commercial drives and powertrains.
It will deepen the critical spirit and the coherent analysis before the problems and their results.
Finally, students will be offered individual and group work with the aim of guiding the student in the search and use of commercial manuals of motors and converters applied to the electric vehicle, looking for their skill in the selection of equipment. . . , sizing of equipment, and decision of installation and necessary connections.

LEARNING OBJECTIVES OF THE SUBJECT

The main objective of the subject is to study the traction systems of electric vehicles, with special emphasis on the most common electric drives and their electronic control.
The course includes the modeling of electric vehicles, the principles of digital control of motors and the description of the industrial equipment needed to use these drives in the field of industrial engineering and electrical mobility.
The student will acquire the knowledge, skills and abilities at a theoretical and practical level necessary to understand and use electronic converters in the field of electric automotive and will know the most common trends and applications.
Practical sessions of simulation, digital programming and use of commercial equipment are included.

STUDY LOAD

Type	Hours	Percentage
Self study	90,0	60.00
Hours small group	30,0	20.00
Hours large group	30,0	20.00

Total learning time: 150 h

CONTENTS

(ENG) Tema 0: PRESENTATION OF THE SUBJECT

Description:
Application of Electric Drives in electric traction.
Presentation of the general contents of the subject and its objectives. Description of the program and the evaluation regulations.
Comment on the basic and complementary bibliography, and the sources of alternative resources.

Full-or-part-time: 2h 30m
Theory classes: 1h
Self study : 1h 30m

(ENG) Tema 1: INTRODUCCIÓ ALS ACCIONAMENTS ELECTRÒNICS EN AUTOMOCIÓ

Description:
Electric traction systems. The drives as part of electric traction systems. AC drives
Drive blocks: converter, motor and vehicle.
Principles of electromechanical conversion: topology of the different types of electric motors and characteristic curves.
Reversibility, braking and speed variation. Energy recovery.

Full-or-part-time: 21h 30m
Theory classes: 4h 30m
Laboratory classes: 4h
Self study : 13h

(ENG) Tema 2: GENERAL MODELS OF ELECTRIC AND HYBRID VEHICLES

Description:
Description of Electric Vehicles: Series and Parallel Configurations. In-Wheel motors
Behavior of engines and loads
Sizing of the electric drive and selection of the motor
Energy storage.

Full-or-part-time: 22h
Theory classes: 5h
Laboratory classes: 4h
Self study : 13h

(ENG) Tema 3: MODELING OF THE ELECTRIC POWERTRAIN OF THE VEHICLE

Description:
Electric traction systems. The drives as part of electric traction systems. AC drives
Drive blocks: converter, motor and vehicle
Principles of electromechanical conversion: topology of the different types of electric motors and characteristic curves
Reversibility, braking and speed variation. Energy recovery.

Full-or-part-time: 22h
Theory classes: 5h
Laboratory classes: 4h
Self study : 13h

(ENG) Tema 4: ELECTRONIC CONTROL OF THE ELECTRIC DRIVE

Description:
Basic control structures: sensors, signal conditioners and controllers.
Torque, speed and position controls.
The four quadrants of engine operation. Acceleration and Energy Recovery.
Vehicle energy management.

Full-or-part-time: 25h
Theory classes: 4h
Laboratory classes: 6h
Self study : 15h

(ENG) Tema 5: ELECTRONIC CONTROL OF THE ELECTRIC VEHICLE

Description:
Vector control of PMSM and IM motor
Direct torque control
High speed control: weakening of flows
Energy control: energy management of batteries

Full-or-part-time: 35h
Theory classes: 5h 30m
Laboratory classes: 8h
Self study : 21h 30m

(ENG) Tema 6: CHARGING INFRASTRUCTURES

Description:
Vehicle recharge type
Models of operation of the recharging pylons
Installation of recharging points: filters and protections
Communications with the infrastructure

Full-or-part-time: 22h
Theory classes: 5h
Laboratory classes: 4h
Self study : 13h

ACTIVITIES

(ENG) EXPOSICIÓ DE CONTINGUTS

Description:
The activity follows the exhibition model of the participatory class. The contents of the subject will be exposed and discussed in class, with interrelation and participation of the students in the form of questions and interventions related to the material, the applications, or the forecasts of future of the technology.

Full-or-part-time: 64h
Theory classes: 24h
Self study: 40h

(ENG) LABORATORI EXPERIMENTAL

Full-or-part-time: 75h
Practical classes: 30h
Self study: 45h

(ENG) PROVA PARCIAL

Full-or-part-time: 2h
Theory classes: 2h

(ENG) EXAMEN FINAL

Full-or-part-time: 2h
Theory classes: 2h

(ENG) PRESENTACIONS ORALS

Full-or-part-time: 9h
Theory classes: 4h
Self study: 5h

GRADING SYSTEM

The final average mark is obtained from the following partial marks and weights:
Partial exam (first bimester): 20%
Final exam: 30%
Laboratory: 40%
Exposition of a topic by the student: 10%

BIBLIOGRAPHY

Basic:
- Husain, Iqbal. Electric and hybrid vehicles: design fundamentals. 2nd ed. Boca Raton: CRC Press, 2011. ISBN 9781439811757.
- Boldea, I.; Nasar, S.A. Electric drives. Boca Raton: CRC Press, 1999. ISBN 0849325218.

RESOURCES

Other resources:
- Ehsani, Mehrdad. Modern electric, hybrid electric and fuel cell vehicles: fundamentals, theory and design. 2nd ed. CRC Press, 2009. ISBN 9781420053982.
- Merino Azcárraga, J.M.; Convertidores de frecuencia para motores de corriente alterna. McGraw-Hill, 1998. ISBN: 84-481-1233-4.
- Leonhard, W. Control of electrical drives. Berlin: Springer-Verlag, 2001. ISBN: 978-3-540-41820-7.
- Massagués Vidal, Ll. Accionaments elèctrics. Valls: Cossetània, 2005. ISBN: 84-9791-134-2