Course guide
240266 - 240AU122 - Batteries

Last modified: 16/04/2024

Unit in charge: Barcelona School of Industrial Engineering
Teaching unit: 709 - DEE - Department of Electrical Engineering.

Degree: MASTER'S DEGREE IN INDUSTRIAL ENGINEERING (Syllabus 2014). (Optional subject).
MASTER'S DEGREE IN AUTOMOTIVE ENGINEERING (Syllabus 2019). (Optional subject).

Academic year: 2024 **ECTS Credits:** 4.5 **Languages:** Catalan, Spanish, English

LECTURER

Coordinating lecturer: Francisco Díaz González

Others: Francisco Díaz González

PRIOR SKILLS

Self-learning, mathematical calculations, simulation tools.

REQUIREMENTS

Physics, electrical engineering.

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
CEMEI06. Knowledge and abilities which allow to understand, analyse, operate and manage the different sources of energy.
CEEELEC1. Model, analyse, calculate and design power electronic systems..
CEAU 4. (ENG) Explicar els sistemes elèctrics, electrònics i de control de què disposa un vehicle.
CEAU12. (ENG) Dissenyar sistemes i components per a vehicles híbrids i elèctrics, així com infraestructures necessàries per a la recàrrega dels vehicles elèctrics (compotència específica de l'especialitat Electromobilitat).

Generical:
CGAU 1. Ability to apply appropriate knowledge of mathematical aspects, analytical, scientific, instrumental, technological and management, the resolution of the problems of the automotive
CGAU 4. Be able to conduct research, development and innovation in relation to automotive technology.
CGAU10. Adapt to changes, being able to apply new and advanced technologies and other relevant processes, initiative and entrepreneurship
CGAU11. Develop independent learning skills to maintain and enhance the powers of Automotive Engineering, to allow the continued development of the profession.
CGMEI04. (ENG) Realitzar investigació, desenvolupament i in.novació en productes, processos, i mètodes.

Transversal:
CT3. TEAMWORK: Being able to work in an interdisciplinary team, whether as a member or as a leader, with the aim of contributing to projects pragmatically and responsibly and making commitments in view of the resources that are available.

CT4. EFFECTIVE USE OF INFORMATION RESOURCES: Managing the acquisition, structuring, analysis and display of data and information in the chosen area of specialisation and critically assessing the results obtained.

CT5. FOREIGN LANGUAGE: Achieving a level of spoken and written proficiency in a foreign language, preferably English, that meets the needs of the profession and the labour market.

TEACHING METHODOLOGY

The following teaching methodologies are adopted for the course:

- Magistral classes or conferencies (CM): dissertations by the professor or by eventual collaborators.
- Participative classes (PART): joint discussions, as well as the resolution of exercises in the room.
- Short activities (AR): individual development of short activities to apply the knowledge gained in the course.
- Project (PA): knowledge based on the desing, planning and deployment of a project of relatively long extension about a particular topic and applying the knowledge gained in the subject.
- Evaluation activities (EV).

LEARNING OBJECTIVES OF THE SUBJECT

Objectives - To gain basic knowledge on energy storage technologies for electric and hybrid vehicles, emphasizing in batteries and also addressing flywheels and supercapacitors.

STUDY LOAD

Type	Hours	Percentage
Hours large group	40,5	36.00
Self study	72,0	64.00

Total learning time: 112.5 h

CONTENTS

Introduction to the course. Introduction to the energy storage needs in electric vehicles. Representative magnitudes.

Description:
Presentation of the course and revision of the basic concepts needed for its proper development.

Specific objectives:
Review basic concepts for the quantification of energy and power magnitudes in vehicles and their energy storage systems.

Related activities:
Definition of the topics to be addressed in the project to be developed either individually or in groups during the course.

Full-or-part-time: 6h 37m
Theory classes: 3h
Self study : 3h 37m

Energy storage technologies for electric and hybrid vehicles: batteries, flywheels and supercapacitors.

Description:
Operating principles, characteristics, technologies available in the market, basic calculations for device sizing, description of models for simulation and evaluation of the behavior of the storages while in operation.

Specific objectives:
To gain knowledge on diverse energy storage systems.

Related activities:
Project to be done in groups as well as short activities to be addressed individually.

Full-or-part-time: 49h 41m
Theory classes: 19h 30m
Guided activities: 3h
Self study : 27h 11m

Integration of batteries, flywheels and supercapacitors as well, in the power train of electric and hybrid vehicles.

Description:
These contents address the description of the main power conversion systems of an electric or hybrid vehicle (power electronics, electric drive and transmission). These also address the interaction the storage technologies have with the power conversion systems, as well as their influence on the performance of the vehicle.

Specific objectives:
To consolidate the knowledge around the integration of energy storage technologies in the propulsion systems of electric and hybrid vehicles.

Related activities:
Project to be done in groups and short activities to develop individually.

Full-or-part-time: 38h 42m
Theory classes: 9h
Guided activities: 3h
Self study : 26h 42m

The vehicle as an energy storage device out of the transport sector.

Description:
Electric vehicles are intended here as energy storage systems distributed thoughout the territory. This energy can be exploited in other ends out of the transport sector.

Specific objectives:
To define the potential applications of the energy stored in electric vehicles, in other ends out of the transport sector (i.e. electrical grids and buildings).

Related activities:
Project to be done in groups.

Full-or-part-time: 17h 30m
Theory classes: 3h
Self study : 14h 30m

GRADING SYSTEM

Final exam (PECC), 50%
Short activities (AR), 15%
Project (PA), 35%

EXAMINATION RULES.

The use of a calculator is permitted (and needed) for the final exam (PECC). No additional documentation and any other material could be used in the exam. The short activities (AR) should be addressed individually, not in groups, and should be submitted to the professor through Atenea platform when convenient. Finally, the project (PA) is intended to be conducted either individually or in groups, and should be presented to the class during the last session for the course. The report of this project should be submitted to the professor via email.

ABOUT RE-TAKE EXAM: Re-take exam is just an option for those students who did not pass the subject at the end of the course (this means getting a final mark for the subject lower than 5 points out 10 points.) In case of opting for and passing the re-take exam, the final mark for the whole subject will be 5 out 10 points.

BIBLIOGRAPHY

Basic:
- Díaz Gonzalez, Francisco; Sumper, Andreas; Gomis i Bellmunt, Oriol. Energy storage in power systems. Chichester: John Wiley & Sons, 2016. ISBN 9781118971321.