Guia docent
220119 - APV - Vehicles de Propulsió Alternativa

Última modificació: 22/04/2022

Unitat responsable: Escola Superior d'Enginyeries Industrial, Aeroespacial i Audiovisual de Terrassa
Unitat que imparteix: 709 - DÉE - Departament d'Enginyeria Elèctrica.

Titulació: GRAU EN ENGINYERIA EN TECNOLOGIES INDUSTRIALS (Pla 2010). (Assignatura optativa).

Curs: 2022 Crèdits ECTS: 3.0 Idiomes: Anglès

PROFESSORAT

Professorat responsable: JUAN MONTAÑA PUIG
Altres: DAVID GONZALEZ DIEZ

METODOLOGIES DOCENTS

Classroom lectures: In these lectures, teachers will introduce basic concepts of energy storage systems, hybrid architectures, electric motors, drives and system modeling. All these explanations are practically oriented and they will be illustrated with real examples to facilitate their understanding.

Practical classes: In these lectures, that are concentrated in modules 3 and 4, students will practice the concepts introduced in previous modules.

Self-study: Students, organized in teamwork, need to work on the materials provided by teachers in order to develop the assigned homework.

Teachers provide the curriculum and monitoring of activities through ATENEA.

OBJECTIUS D'APRENENTATGE DE L'ASSIGNATURA

This course gives an overview of state of the art on alternative propulsion vehicles. It includes a peer description of the main components, system architectures and operation of common electric powertrains. Most of the contents will be practically introduced by laboratory and modeling implementations.

At the end of the course, students should be able:

- to know the basics principles, components and operation of alternative propulsion systems.
- to model and simulate the performance of these systems.

HORES TOTALS DE DEDICACIÓ DE L'ESTUDIANTAT

<table>
<thead>
<tr>
<th>Tipus</th>
<th>Hores</th>
<th>Percentatge</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hores aprenentatge autònom</td>
<td>45,0</td>
<td>60.00</td>
</tr>
<tr>
<td>Hores grup gran</td>
<td>30,0</td>
<td>40.00</td>
</tr>
</tbody>
</table>

Dedicació total: 75 h
### Module 1: Introduction to Alternative Propulsion Vehicles

**Descripció:**
This module introduces basics on alternative propulsion vehicles. It is focused on pure electric and hybrid electric vehicles. State of the art of current technologies is presented as future trends as well.

**Contents:**
1.1 General architectures of electric vehicles  
1.2 Basic components: motors, power drives and energy storage  
1.3 General architectures of hybrid electric vehicles

**Objectius específics:**
Identify the components of full electric and hybrid electric vehicles.  
Understand the function of each component.

**Activitats vinculades:**
Final exam

**Dedicació:** 12h 30m  
Classes teòriques: 5h  
Aprenatatge autònom: 7h 30m

### Module 2: Principles of Electric Drives

**Descripció:**
This module deals with the principles of electric drives focusing on the operation of the typical electric and hybrid-electric power trains.

**Contents:**
2.1 Battery packs.  
2.2 Power processing units for motor-generator and battery packs.  
2.3 Operation of typical power trains.

**Objectius específics:**
- Understand all major components of a typical electric vehicle powertrain  
- Describe the operation of accumulators, power electronic converters, motor-generators, on-board and off-board charging systems.

Classify different types of accumulators, power converters and electric machines commonly used in power trains for electric vehicles.

**Activitats vinculades:**
Final exam.

**Dedicació:** 12h 30m  
Classes teòriques: 5h  
Aprenatatge autònom: 7h 30m
Module 3: Laboratory of Electric Machines and Drives

Descripció:
This module is devoted to practice implementation of electric drives. The laboratory is equipped with permanent magnet synchronous motors (PMSM/BLDC) mounted in wheels, three-phase electronic converters and dSPACE platforms for quick experiment implementation with Matlab/Simulink.

Contents:
3.1 Introduction to the laboratory.
3.3 First steps with dSPACE, Simulink, and ControlDesk.
3.2 Basic drive of a PMSM/BLDC motor.
3.3 Throttle control of a PMSM/BLDC motor.
3.4 Brake control of a PMSM motor.
3.5 Regenerative breaking of a PMSM/BLDC motor.

Objectius específics:
To practice with real electric vehicle components. 
Programing efficient control techniques for propulsion and breaking. 
Familiarize with electric motors, power electronics, rapid prototyping systems and instruments. 
Evaluate performance and efficiency

Activitats vinculades:
Laboratory work related to Module 3
Final exam

Dedicació: 25h
Classes teòriques: 10h
Aprenentatge autònom: 15h

Module 4: Modeling & Simulation

Descripció:
This module is devoted to the modeling and simulation of pure electric/hybrid vehicles using numerical simulation. Modeling is useful for system sizing, design an predicting vehicle performance.

Contents:
4.1 Modeling of electric motor.
4.2 Modeling of power electronics converter.
4.3 Modeling of transmission system.
4.4 Modeling of final drive and wheel.
4.5 Modeling of vehicle body

Objectius específics:
Formulate the mechanical physical model of an electric/hybrid vehicle. 
Model the electric motor, power electronic converter and batteries. 
Determine the performance and evaluate the efficiency.

Activitats vinculades:
Autonomous work related to module 4
Final exam.

Dedicació: 25h
Classes teòriques: 10h
Aprenentatge autònom: 15h
SISTEMA DE QUALIFICACIÓ

BIBLIOGRAFIA

Bàsica:

Complementària:

RECURSOS

Altres recursos:
Documentation available in Atenea