This course gives an overview of state of the art on alternative propulsion vehicles. It includes a peer description of the main components 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.
## 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

**Activitats vinculades:**
Final exam

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

## 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.

**Activitats vinculades:**
Final exam.

**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.
**Module 3: Laboratory of Electric Machines and Drives**

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<thead>
<tr>
<th>Dedicació: 25h</th>
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<tr>
<td>Classes teòriques: 10h</td>
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<td>Aprenentatge autònom: 15h</td>
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**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.

**Activitats vinculades:**
Laboratory work related to Module 3
Final exam

**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.
### Module 4: Modeling & Simulation

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<thead>
<tr>
<th>Description:</th>
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<tbody>
<tr>
<td>This module is devoted to the modeling and simulation of pure electric/hybrid vehicles using numerical simulation. Modeling is useful for system sizing, design and predicting vehicle performance.</td>
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<table>
<thead>
<tr>
<th>Contents:</th>
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<tbody>
<tr>
<td>4.1 Modeling of electric motor.</td>
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<td>4.2 Modeling of power electronics converter.</td>
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<td>4.3 Modeling of transmission system.</td>
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<td>4.4 Modeling of final drive and wheel.</td>
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<td>4.5 Modeling of vehicle body</td>
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<th>Activitats vinculades:</th>
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<tbody>
<tr>
<td>Autonomous work related to module 4</td>
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<td>Final exam.</td>
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<tr>
<th>Objectius específics:</th>
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<tbody>
<tr>
<td>Formulate the mechanical physical model of an electric/hybrid vehicle.</td>
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<tr>
<td>Model the electric motor, power electronic converter and batteries.</td>
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<tr>
<td>Determine the performance and evaluate the efficiency.</td>
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</table>

### Sistema de qualificació
220119 - Vehicles de Propulsió Alternativa

**Bibliografia**

**Bàsica:**


**Complementària:**


**Altres recursos:**

Documentation available in Atenea