COMILLAS
UNIVERSIDAD PONTIFICIA
ICAI ICADE CIHS

GUÍA DOCENTE
2025 - 2026

FICHA TÉCNICA DE LA ASIGNATURA

Datos de la asignatura

Nombre completo	Electric Vehicles
Código	DIM-MMS-525
Impartido en	Máster Universitario en Ingeniería Industrial + Máster in Motorsport, Mobility and Safety [Segundo Curso] Máster Universitario en Ingeniería Industrial + Máster in Motorsport, Mobility and Safety [Segundo Curso] Master in Motorsport, Mobility and Safety [Primer Curso]
Nivel	Master
Cuatrimestre	Semestral
Créditos	3,0 ECTS
Carácter	Obligatoria
Departamento / Área	Departamento de Ingeniería Mecánica

Datos del profesorado

DATOS ESPECÍFICOS DE LA ASIGNATURA

Contextualización de la asignatura

Aportación al perfil profesional de la titulación

Electric cars are frequently presented as the sustainable alternative to internal combustion engine vehicles and as the potential solution to the emissions problems of many major cities in the world. This course discusses the evolution of propulsion systems and how these systems drive the modifications of other vehicle subsystems. Current challenges in electric vehicles include questions about how to extend the range of battery powered vehicles, efficiency in the recharge and how this technology can be applied to other means of transport.

Prerrequisitos

Basic knowledge of vehicle systems

Competencias - Objetivos

Competencias

Specific Competences

SC1: Understand the structure and function of modern propulsion systems, including electric, hybrid, and hydrogen-based technologies.

SC2: Identify and describe the main components involved in electric and hybrid powertrains (motors, batteries, converters, control systems).

SC3: Understand and apply technical and regulatory considerations related to energy efficiency, safety, environmental impact and sustainability in advanced propulsion systems.

SC4: Analyze and evaluate vehicle architectures and component integration from both a functional and efficiency standpoint.

SC5: Compare and assess propulsion alternatives for different transport sectors (light-duty, heavy transport, public transit).

Transversal Competences (Based on the 2018 EU Recommendation)

TC1 – STEM Competence: Ability to apply engineering, physics, and technology knowledge in the analysis and design of sustainable powertrain systems.

TC2 – Digital Competence: Effective use of digital tools and data for modelling, system integration, energy efficiency analysis, and technical decision-making.

TC3 – Learning to Learn: Capacity to adapt to rapidly evolving technologies in the automotive and energy sectors through autonomous and continuous learning.

TC4 – Entrepreneurship Competence: Ability to identify innovative opportunities in the field of clean propulsion and sustainable transport systems.

TC5 – Communication Competence: Clear and effective communication of technical concepts and design solutions to both specialist and non-specialist audiences.

Resultados de Aprendizaje

K1: Describe the evolution and types of vehicle propulsion systems, including internal combustion, hybrid, battery electric, and hydrogen-based technologies.

K2: Understand the function and integration of electric drivetrain components: motors, inverters, converters, batteries, and thermal systems.

K3: Explain the principles and challenges of vehicle electrification, including charging systems, battery architecture and thermal management.

K4: Identify key safety aspects and regulations applicable to electric and hydrogen vehicles (e.g. high-voltage systems, EURO 7).

K5: Understand the environmental and societal implications of deploying new propulsion systems, including life cycle analysis, recycling and energy infrastructure.

S1: Analyze and compare propulsion architectures (central motor vs. in-wheel, ICE vs. BEV vs. FCEV).

S2: Evaluate component interactions and energy flows in hybrid and electric systems for efficiency and performance.

S3: Propose charging and energy storage solutions adapted to vehicle type and use-case, taking thermal and electrical constraints into account.

S4: Interpret and apply relevant standards and safety regulations for the design and integration of propulsion components.

S5: Use technical documentation and simulation tools to support engineering decisions in the context of clean vehicle technologies.

C1: Demonstrate critical thinking and autonomy when assessing and selecting propulsion technologies aligned with sustainability goals.

C2: Keep up to date with emerging propulsion trends, demonstrating self-learning capacity and curiosity.

C3: Communicate engineering proposals and project results effectively, adapting the discourse to different stakeholders.

BLOQUES TEMÁTICOS Y CONTENIDOS

Contenidos – Bloques Temáticos

- **Propulsion systems: evolving from traditional systems to new technologies**
  New propulsion technologies
  Hybrid vehicles definition
  Levels of hybridation
  Hybrid/electrical vehicle arquitectures
- **Component modifications between internal-combustion-engine and battery electric vehicles**
  Transmission systems
  Central engine vs. in-wheel electric motors
- **Electrical drivetrain main components**
  ICE used in hybrid vehicles
  Electric motors and Generators
  Inverters and Converters
  HV EDS
  Regenerative brakes
  Thermal management
- **Batteries**
  Battery system
  Types of batteries
  Array and cell architecture
  Cooling needs and methods
- **The charge of electric vehicles**
  Plug-in charging
  Wireless charging
  Impact on electric network
- **Safety & potential hazards associated to electric vehicles**
  Regulations
  Safety systems
  Transport
  Recycling and second life
- **Hydrogen and Heavy Transport**
  Climate change and the need to decarbonize heavy transport
  Regulatory context – EURO 7
  Why hydrogen and why now?
  The hydrogen industry: Production and uses
  Hydrogen properties
  Hydrogen storage in vehicles

Fuel cell

Hydrogen combustion engine

METODOLOGÍA DOCENTE

Aspectos metodológicos generales de la asignatura

EVALUACIÓN Y CRITERIOS DE CALIFICACIÓN

Calificaciones

- In-class quizzes. 10%
- End of term exam. 70%
- Short homework. 20%

BIBLIOGRAFÍA Y RECURSOS

Bibliografía Básica

- Handouts provided by the instructors in class.
- Additional reading provided in Moodle.
- Vukan R. Vuchic. Transportation for Livable Cities. CUPR Press. 1999.
- Jacobs, Jane. The death and life of great American cities. Vintage, 2016.