GUÍA DOCENTE
2025 - 2026

FICHA TÉCNICA DE LA ASIGNATURA

Datos de la asignatura

Nombre completo	Sustainable Mobility
Código	DIM-MMS-505
Impartido en	Máster Universitario en Ingeniería Industrial + Máster in Motorsport, Mobility and Safety [Primer Curso] Máster Universitario en Ingeniería Industrial + Máster in Motorsport, Mobility and Safety [Primer Curso] Master in Motorsport, Mobility and Safety [Primer Curso]
Nivel	Master
Cuatrimestre	Anual
Créditos	3,0 ECTS
Carácter	Obligatoria
Departamento / Área	Departamento de Ingeniería Mecánica
Horario	Wednesday, 17:00 a 19:00

Datos del profesorado

Profesor

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Profesor

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DATOS ESPECÍFICOS DE LA ASIGNATURA

Contextualización de la asignatura

Aportación al perfil profesional de la titulación

The course is based on a series of lectures delivered by specialists, with the aim of providing a broad overview of mobility in general and, in particular, of sustainable mobility, through the expertise of professionals from the sector

Prerrequisitos

There are no prerequisites

Competencias - Objetivos

Competencias

- **Scientific, Technological and Engineering Competence** – Ability to understand environmental impacts of mobility, regulatory frameworks, and technological solutions such as low-carbon fuels and traffic simulation tools
- **Digital Competence** – Confident and critical use of digital tools for traffic simulation, emissions monitoring, and data analysis in mobility contexts
- **Citizenship Competence** – Awareness of sustainable development goals, social responsibility in mobility choices, and engagement with public policies on emissions and urban mobility
- **Entrepreneurship Competence** – Capacity to identify opportunities for innovative mobility solutions, assess feasibility and costs, and propose sustainable alternatives
- **Personal, Social and Learning to Learn Competence** – Ability to work collaboratively in practical sessions, critically reflect on mobility systems, and develop problem-solving strategies
- **Multilingual and Communication Competence** – Effective communication of findings, both orally and in writing, in an international and interdisciplinary academic environment
- **Cultural Awareness and Expression Competence** – Recognition of the cultural, social, and behavioural dimensions of urban mobility systems and their impact on sustainability

Resultados de Aprendizaje

- **Explain** the environmental impacts of mobility and the regulatory frameworks governing greenhouse gas and local pollutant emissions.
- **Apply** life cycle analysis and simulation tools to evaluate mobility options and their environmental costs.
- **Measure and analyze** real-world vehicle emissions using appropriate instruments and methodologies.
- **Compare** different low-carbon fuel pathways (fossil alternatives, biofuels, PtX, waste-based) in terms of efficiency, emissions, and costs.
- **Assess** the challenges and opportunities of urban mobility systems, identifying factors influencing transport choices and sustainability outcomes.
- **Collaborate** effectively in practical sessions, demonstrating critical thinking, teamwork, and problem-solving skills.
- **Communicate** results, proposals, and reflections on sustainable mobility in a clear, structured, and professional manner.

BLOQUES TEMÁTICOS Y CONTENIDOS

Contenidos – Bloques Temáticos

1. Introduction
    1. Energy consumption by sector
    2. Environmental impacts of mobility
        1. Tool for comparing environmental impacts: life cycle analysis
        2. Greenhouse gas emissions: regulatory framework by sector
        3. Local pollutant emissions: regulatory framework by sector
2. Low-carbon intensity fuels for thermal engines
    1. Fossil: natural gas and LPG
    2. Biofuels
        1. Biomass production and processing (conventional, algae, genetically modified organisms, etc.)
        2. Indirect land-use changes
        3. Fermentation and alcohol production

4. Transesterification
5. Lipid hydrogenation
6. Thermochemical processing: pyrolysis, gasification + Fischer-Tropsch
7. Hydrothermal liquefaction

3. Fuels from waste
    1. Waste management
    2. Processing (overlapping with many biomass processes)
    3. Power to Liquids/Gases (PtX)
    4. Concentrated CO_2 and atmospheric CO_2 recovery
    5. PtX production pathways (routes to H_2, methanol, gasoline, diesel, DME)
4. Comparison of all options in terms of greenhouse gases and cost

3. Visit to Repsol Lab
4. Urban mobility systems (2h, Fernando Alstom)
    1. Some figures on mobility in Europe
    2. Cities: their role and limitations; root causes of urban traffic; traffic intensity they can handle
    3. Urban transport as a reflection of today's society: The Pedestrian Rights Charter
    4. The choice of transport modes: reflections on the total cost of travel
    5. Sustainable mobility: what does the end user seek?
    6. Different modes of urban transport and characteristics of the different collective transport modes
    7. Decision-making factors for choosing the optimal urban transport mode
    8. Key success factors of the urban transport system
5. Emissions. Measurements (6h, Javier Buhigas, OPUS RSE.)
    1. **Real vehicle emissions and their measurement under real driving conditions**
        1. Differences between homologation emissions and real-world emissions
        2. The use of RSD technology for large-scale measurement of real-world emissions
        3. Science, physical principles, and typology of RSD data
    2. **Applications of RSD for sustainable mobility – Part 1**
        1. Refinement of emission factors and air quality models
        2. Automotive market supervision and regulation
        3. Support for urban mobility policies and low-emission zones
        4. Project examples and results
    3. **Applications of RSD for sustainable mobility – Part 2**
        1. Identification of high-emitting vehicles
        2. Identification of illegally tampered vehicles
        3. Control and auditing of truck and bus fleets
        4. Meso- and micro-scale simulation of road traffic emissions to improve mobility
        5. Project examples and results
    4. Practical session
6. Traffic simulation (6h, Josep Aymami, Aimsun)
    1. **Theoretical session**
        1. Introduction to transport models
        2. What are models? Why are they necessary?
        3. Types of models
        4. The different elements that make up a transport network
        5. Macroscopic model
            1. Basic principles
        6. Microscopic model

1. Basic principles. Parameters

7. Elements needed to create a simulation model
    1. Geometry
    2. Demand
    3. Control
8. Results
9. Examples

2. **Hands-on session**
    1. Aimsun Next: Introduction to the software
    2. Generalities
    3. Introduction of necessary elements: sections, nodes, centroids, matrices, public transport, parameters
    4. Simulation
    5. Evaluation of results: types of statistics

7. Conferences. The rest of the hours will be covered by 2-hour lectures on different topics about sustainable mobility. The speakers will expert on the area. Different topic could be: Manage Madrid urdergroud, new technologies in mobility, shared mobility, administration and companies tools for mobility….

METODOLOGÍA DOCENTE

Aspectos metodológicos generales de la asignatura

Metodología Presencial: Actividades

The course is based on lectures. During them, students are invited to debate some of the ideas presented by the lecturers.

Additionally, there will be a practical session on real-time measurements of vehicle emissions. Other sessions will focus on traffic flow simulation, as well as a visit to Repsol's fuel laboratory.

Metodología No presencial: Actividades

In addition to studying the lecture notes, students will be required to complete a traffic simulation project.

RESUMEN HORAS DE TRABAJO DEL ALUMNO

- Class attendance: 30 hours
- Completion of post-class tests: 4 hours
- Traffic simulation project: 6 hours
- Preparation for the final test: 10 hours

EVALUACIÓN Y CRITERIOS DE CALIFICACIÓN

The activities for assessing the course are:

- Post-session tests
- Traffic simulation project:
- Practical session on measurements

- Final test

Calificaciones

- Post-session tests: 10%
- Traffic simulation project: 30%
- Practical session on measurements: 10%
- Final test: 50%

To pass the course, the average grade must be higher or equal to 5 points

BIBLIOGRAFÍA Y RECURSOS

Bibliografía Básica

- **Transportation for Livable Cities**. Autor: Vukan Vuchic. Editor: CUPR Press. 1999
- **Urban Transit-Operation, Planning & Economics**. Autor: Vukan Vuchic. Editor: John Wiley & Sons. 2005
- **Urban Transit-Systems & Technology**. Autor: Vukan Vuchic. Editor: John Wiley & Sons. 2007
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