COMILLAS
UNIVERSIDAD PONTIFICIA
ICAI ICADE CIHS

GUÍA DOCENTE
2026 - 2027

FICHA TÉCNICA DE LA ASIGNATURA

Datos de la asignatura	
Nombre completo	Integrated Safety and Restraint Systems
Código	DIM-M2S-612
Impartido en	Máster Universitario en Ingeniería Industrial + Máster in Motorsport, Mobility and Safety [Segundo Curso] Master in Motorsport, Mobility and Safety [Segundo Curso]
Nivel	Master
Cuatrimestre	Semestral
Créditos	3,0 ECTS
Carácter	Obligatoria
Departamento / Área	Departamento de Ingeniería Mecánica
Responsable	Francisco J. López Valdés
Horario	Friday, 5 pm - 7 pm
Descriptor	The course will review the main concepts associated to restraint systems, including the basic mechanics behind their development and current developments integrating pre-crash features. New restraint concepts will be discussed and illustrated with examples.

Datos del profesorado	
Profesor	
Nombre	Francisco José López Valdés
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Profesor	
Nombre	Jaime Espinosa de los Monteros García-Frías
Departamento / Área	Departamento de Ingeniería Mecánica
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Profesor	
Nombre	Sergio Crespo Royo
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DATOS ESPECÍFICOS DE LA ASIGNATURA

Contextualización de la asignatura

Aportación al perfil profesional de la titulación

After taking this class the student will be able to:

- identify the main strategies to design an effective restraint system
- be familiar with the standards and regulations used by industry in the design of restraint systems
- know state-of-the-art tools and methods used in the design of restraint systems
- run FE simulations of restraint systems using the Ls-Dyna code

Prerrequisitos

Knowledge of injury biomechanics, continuum mechanics and basic epidemiology

Competencias - Objetivos

BLOQUES TEMÁTICOS Y CONTENIDOS

Contenidos – Bloques Temáticos

Part A: Fundamentals of occupant restraints

1. Definition of active and passive safety. Integrated safety. (4 hours, FLV)
    1. Haddon/Safe Systems approach to injury prevention
    2. Injury prevention effectiveness of seat belts and airbags
    3. Relationship to autonomous/automated vehicles
2. Desirable kinematics of the adult occupant attending to its biomechanical characteristics (4 hours, FLV)
    1. Horsch, Adomeit papers
    2. Submarining and recline postures
3. Child restraint systems: regulations, challenges, pediatric dummies (2 hours, FLV)

Part B: Restraint systems: how they work and development of restraint systems

1. Seat belt and airbags: introduction, types, components, regulation, desired performance. (3 hours, BP)
    1. Front seat vs. Rear seat
    2. Standards and regulation (ECE-R16)
    3. Types of airbags: passenger/occupant, curtain, knee, …
2. The THOR dummy and the Hybrid III (1 hours, BP)
    1. Chest instrumentation
    2. Associated injury criteria related to restraint systems performance
3. Application of human body models to the development of restraint systems (2 hours, BP)
    1. THUMS, SAFER HBM and other human body models
    2. Challenges in the use of human body models in the design of restraint systems
    3. Virtual testing and the use of Human Body Models in consumer information programmes (Euro NCAP)
4. Advanced restraint systems and pre-crash activation (1 hours, BP)

1. Combined activation of restraint and pre-crash systems
2. The use of human body models in the development and optimization of restraint systems.

5. Protection of motorcyclists: helmets and protective equipment (2 hours, Sergio Crespo)

Part C: Using virtual testing to understand the physics of restraint systems.

1. Introduction to the use of virtual dummies in LSTC (2 hours, Jaime Espinosa de los Monteros)
    1. Introduction to LSTC virtual dummies
    2. Positioning a dummy on the test rig
2. Belt routing and definition (2 hours, Jaime Espinosa de los Monteros)
3. Re-positioning a dummy and belt update (2 hours, Jaime Espinosa de los Monteros)
4. Setting up a simulation (2 hours, Jaime Espinosa de los Monteros)
    1. Boundary, loading and initial conditions
    2. Setting up and running a virtual test
5. Simulation debugging (2 hours, Jaime Espinosa de los Monteros)
6. Simulation postprocessing (2 hours, Jaime Espinosa de los Monteros)
    1. Accessing dummy channels. Injury metrics
    2. Quality control
7. Test – simulation correlation (2 hours, Jaime Espinosa de los Monteros)
    1. Compare test/sim data. Error metrics
8. Parametric studies (1 hour, Jaime Espinosa de los Monteros)

METODOLOGÍA DOCENTE

Aspectos metodológicos generales de la asignatura

EVALUACIÓN Y CRITERIOS DE CALIFICACIÓN

Standard evaluation at the end of the term:

- 30% Part A class quizzes
- 20% Part B project or exam
- 50% Part C project

Additional evaluation during July (Retake):

- 20% Part B project or exam
- 50% Part C Project
- 30% Part A paper critique

BIBLIOGRAFÍA Y RECURSOS

Bibliografía Básica

Yoganandan N, Nahum AM, Melvin JW, Accidental Injury. Biomechanics and Prevention. 3rd edition. Springer, 2015.

Arregui C, Luzón J, López-Valdés FJ, Del Pozo de Dios E, Seguí-Gómez M, Fundamentos de Biomecánica en las Lesiones por Accidente de Tráfico 2ª edición, ETRASA Madrid, 2010 ISBN: 978-84-92625-40-6

Ad-hoc papers provided by instructors