COMILLAS
UNIVERSIDAD PONTIFICIA
ICAI ICADE CIHS

GUÍA DOCENTE
2023 - 2024

FICHA TÉCNICA DE LA ASIGNATURA

Datos de la asignatura	
Nombre completo	Injury Biomechanics
Código	DIM-MMS-514
Cuatrimestre	Semestral
Créditos	3,0 ECTS
Carácter	Obligatoria
Departamento / Área	Departamento de Ingeniería Mecánica
Responsable	Francisco José López Valdés
Descriptor	Injury biomechanics is the part of biomechanics that analyzes how external energy can damage tissue and characterizes the mechanical threshold of the tissue with the goal of preventing injuries. Students will receive basic contents about anatomy and most frequent injuries occurring in relevant scenarios (i.e., vehicle collisions), complemented by the introduction to the biomechanical experiments that set the bases for existing injury criteria. The course will also cover some of the most advanced research in the protection of road users.

Datos del profesorado	
Profesor	
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DATOS ESPECÍFICOS DE LA ASIGNATURA

Contextualización de la asignatura

Prerrequisitos

Knowledge of basic courses of materials science and strength of materials.

Competencias - Objetivos

Competencias

Basic and general competences

GC01 To understand the basic principles that support the development of new methods and theories.

GC02 To foster the initiative, creativity, decision taking, critical thinking, teamwork and communication skills within the field of mechanical engineering.

Specific competences

SC01 To understand the basic principles in injury biomechanics that can contribute to prevent injuries in human beings.

SC02 To understand, identify and discuss the main limitations and advantages of the different human surrogates used in the field of injury biomechanics.

Resultados de Aprendizaje

LR1. To know the basic anatomical terms used in the study of biomechanics

LR2. To understand the Haddon and Safe System approach to the prevention of injuries caused by external causes.

LR3. To understand the basic mechanical properties of the most important connective tissues in the human body and to relate them to mechanical concepts studied in courses of solid mechanics, elasticity, etc.…

LR4. To learn the basic concepts behind the development of the Abbreviated Injury Scale.

LR5. To learn the different surrogates used in Injury Biomechanics and the pros and cons of each one.

LR6. To become familiar with the main injury criteria used in regulation and consumer testing programs tests and to develop a critical perspective.

LR7. To understand the development of injury criteria and to be able to develop an adjusted injury criteria for newly obtained experimental data.

LR8. To learn the most important injury mechanisms of different body regions and to become familiar with the experimental/computational tests that contributed to their development.

LR9. To be able to adopt a critical perspective in the reading of scientific papers.

BLOQUES TEMÁTICOS Y CONTENIDOS

Contenidos – Bloques Temáticos

Theory:

1. Introduction to injury prevention
2. Introduction to human anatomy and anatomical terms.
    - Review of general anatomy and anatomical terms
3. Cells and connective tissue of the musculoskeletal system
    - Connective tissue
    - Bone tissue
    - Ligaments and tendons
    - Cartilage
    - Muscles

4. Injury scales.
    - Injury scales, focus on AIS (Abbreviated Injury Scale)
5. Crash surrogates and related biomechanical experiments: volunteers, animals, Post-Mortem Human Surrogates and human body models
6. Injury criteria
    - Statistical methods
    - Development of injury criteria
    - Examples of most relevant injury criteria used in automotive industry
7. Review of body regions and related injuries and biomechanical data
    - Head
    - Cervical spine, thoracic spine and lumbar spine
    - Thorax
    - Abdomen
    - Lower extremities
8. Challenges in injury biomechanics
    - Age effects
    - Sex effects
    - Anthropometry effects
    - Pediatric biomechanics

Laboratory:

Practice 1

Several samples will be exposed to tests up to fracture. Students will have to develop an injury criterion for the fracture of an organic sample (2.5 hours).

Practice 2

A sled test will be carried out with the Hybrid III dummy. Students will have to calculate the risk of injury as predicted by the dummy using the most relevant injury criteria (2.5 hours).

METODOLOGÍA DOCENTE

Aspectos metodológicos generales de la asignatura

Two types of learning modes are planned both for the in-class activities and the remote activities: individualized and collaborative. The individualized mode is intended to be completed by each individual student. In the collaborative mode, students will be split into groups of three people that will work together to solve a task.

EVALUACIÓN Y CRITERIOS DE CALIFICACIÓN

Standard evaluation at the end of the term:

- 20% Lab project 1
- 20% Lab project 2
- 20% Quiz/quizzes on reading materials provided by the instructor

- 15% Homework
- 25% Critique of a relevant published paper

Attendance: minimum 85% to be allowed to take the exam.

Additional evaluation during July (Retake):

- 25% Lab project 1 (individual)
- 25% Lab project 2 (individual)
- 50% Critique of a relevant published paper

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
- Bartel D, Dave D, Keaveny T. Orthopeadic Biomechanics: Mechanics and Design in Musculoskeletal Systems. 1st edition. Pearson. 2006 ISBN-13: 978-0130089090
- Scientific papers provided by the instructor.