ANX-PR/CL/001-01

LEARNING GUIDE

SUBJECT

43000605 - Materiales BiolÓgicos

DEGREE PROGRAMME

04AN - Master Universitario En Ingenieria De Materiales

ACADEMIC YEAR & SEMESTER

2023/24 - Semester 1

Index

Learning guide

1. Description

1.1. Subject details

Name of the subject	43000605 - Materiales Biológicos
No of credits	4.5 ECTS
Type	Compulsory
Academic year ot the programme	First year
Semester of tuition	Semester 1
Tuition period	September-January
Tuition languages	English
Degree programme	04AN - Master Universitario en Ingenieria de Materiales
Centre	04 - Escuela Tecnica Superior De Ingenieros De Caminos, Canales Y Puertos
Academic year	2023-24

2. Faculty

2.1. Faculty members with subject teaching role

Name and surname	Office/Room	Email	Tutoring hours *
Blanca De Los Reyes Gonzalez Bermudez	Dep C Mater	blanca.gbermudez@upm.es	Sin horario. Please contact the professor for a tutorial session
Gustavo Victor Guinea Tortuero		gustavovictor.guinea@upm.es	M - 15:00 - 18:00 Tu - 16:00 - 18:00

Francisco Javier Rojo Perez	Dep C Mater	fj.rojo@upm.es	Sin horario. Please contact the professor for a tutorial session
Gustavo Ramon Plaza Baonza (Subject coordinator)	Dep C Mater	gustavo.plaza@upm.es	Sin horario. Please contact the professor for a tutorial session

* The tutoring schedule is indicative and subject to possible changes. Please check tutoring times with the faculty member in charge.

3. Prior knowledge recommended to take the subject

3.1. Recommended (passed) subjects

The subject - recommended (passed), are not defined.

3.2. Other recommended learning outcomes

- Mechanics of materials

4. Skills and learning outcomes *

4.1. Skills to be learned

CB06 - Poseer y comprender conocimientos que aporten una base u oportunidad de ser originales en el desarrollo y/o aplicación de ideas, a menudo en un contexto de investigación

CB09 - Que los estudiantes sepan comunicar sus conclusiones y los conocimientos y razones últimas que las sustentan a públicos especializados y no especializados de un modo claro y sin ambigüedades

CB10 - Que los estudiantes posean las habilidades de aprendizaje que les permitan continuar estudiando de un modo que habrá de ser en gran medida autodirigido o autónomo.

CE1 - Capacidad para aplicar los fundamentos científicos del comportamiento físico y químico de los materiales para relacionar causalmente sus propiedades fundamentales físicas y químicas con su comportamiento

macroscópico y el de los productos con ellos realizados / Ability to apply the scientific foundations of the physical and chemical behavior of materials to correlate their fundamental physical and chemical properties with their macroscopic behavior and that of the products made with them.

CE8 - Aplicación del método científico para la resolución de problemas y la generación de conocimiento / Application of the scientific method to solve problems and generate knowledge

CG8 - Resolución de problemas: Los estudiantes son capaces de reconocer, describir, organizar y analizar los elementos constitutivos de un problema para idear estrategias que permitan obtener, de forma razonada, una solución contrastada y acorde a ciertos criterios preestablecidos / Problem solving: Students are able to recognize, describe, organize and analyze the constitutive elements of a problem to devise strategies that allow obtaining, in a reasoned way, a contrasting solution and according to certain pre-established criteria.

CG9 - Análisis y Síntesis: Los alumnos son capaces de reconocer y describir los elementos constitutivos de una realidad, y de proceder a organizar la información significativa según criterios preestablecidos adecuados a un propósito / Analysis and Synthesis: Students are able to recognize and describe the constituent elements of a reality, and to proceed to organize significant information according to pre-established criteria suitable for a purpose.

CG9 - Que los estudiantes sepan comunicar sus conclusiones y los conocimientos y razones últimas que las sustentan a públicos especializados y no especializados de un modo claro y sin ambigüedades

4.2. Learning outcomes

RA2 - Ser capaz de aprender y actualizar autónomamente nuevos conocimientos y técnicas

RA4 - Que los estudiantes sepan comunicar sus conclusiones (y los conocimientos y razones últimas que las sustentan) a públicos especializados y no especializados de un modo claro y sin ambigüedades

RA3 - Conocer, comprender y saber aplicar las bases de la ciencia y del método científico

RA8 - RA32 - Conocer, comprender y saber aplicar los fundamentos científicos del comportamiento de los materiales

* The Learning Guides should reflect the Skills and Learning Outcomes in the same way as indicated in the Degree Verification Memory. For this reason, they have not been translated into English and appear in Spanish.

5. Brief description of the subject and syllabus

5.1. Brief description of the subject

Justification and Objectives
The student will acquire:

1. Detailed understanding of structure of biological materials.

2. Knowledge of most important mechanical models applied to biological materials

3. Detailed understanding of modeling, mainly in 1D (fibers) and 2D (membranes)

4. Basic undertanding of large-deformation modeling in 3D.

5. Knowledge of examples of one-dimensional and bidimensional biological materials.

5.2. Syllabus

1. Biological fibers: general concepts
2. Biological fibers: elastomeric behaviour and characterization techniques
3. Biological fibers: Introduction to viscoelasticity
4. Biological fibers: Fracture. Weibull model
5. Biological fibers: examples (cotton, wool, silk, collagen)
6. Biological membranes: general concepts
7. Biological membranes: introduction and characterization techniques
8. Biological membranes: introduction to Continuum Mechanics
9. Biological membranes: Tear strength and characterization
10. Biological membranes: examples (pericardium, blood vessels)

6. Schedule

6.1. Subject schedule*

Week	Classroom activities	Laboratory activities	Distant / On-line	Assessment activities
1	**Presentation. Fibrillar biological materials. Tension, tensile testing, strain?stress definitions. Polymeric (bio)materials. Elastomeric behavior (I)** Duration: 02:00			
2	**Elastomeric behavior (II). Silk fibers: composition, microstructure, properties.** Duration: 02:00			**Exercises to be solved individually at home** Continuous assessment Not Presential Duration: 01:00
3	**Viscoelasticity of biological materials (I)** Duration: 02:00			
4	**Viscoelasticity of biological materials (II)** Duration: 02:00			**Exercises to be solved individually at home** Continuous assessment Not Presential Duration: 01:00
5	**Viscoelasticity of biological materials (III)** Duration: 02:00			**Exercises to be solved individually at home** Continuous assessment Not Presential Duration: 01:00
6	**Fracture of biological fibers. Weibull model** Duration: 02:00			**Exercises to be solved individually at home** Continuous assessment Not Presential Duration: 01:00
7	**Examples of biological fibers** Duration: 02:00			**Questionnaire to be solved individually at home** Continuous assessment Not Presential Duration: 00:30
8	**Introduction to bidimendional biological materials. Mechanics of bidimendional and 3D biological materials (I)** Duration: 02:00			**Exercises to be solved individually at home** Continuous assessment Not Presential Duration: 01:00

9	**Mechanics of bidimendional and 3D biological materials (II)** Duration: 02:00			**Exercises to be solved individually at home** Continuous assessment Not Presential Duration: 01:00
10	**Mechanics of bidimendional and 3D biological materials (III)** Duration: 02:00			**Exercises to be solved individually at home** Continuous assessment Not Presential Duration: 02:00
11	**Fracture of biological membranes: Tear strength** Duration: 02:00			**Exercises to be solved individually at home** Continuous assessment Not Presential Duration: 02:00
12	**Examples of bidimensional biological materials** Duration: 02:00			**Questionnaire to be solved individually at home** Continuous assessment Not Presential Duration: 00:30
13	**Oral presentations** Duration: 02:00			
14	**Oral presentations** Duration: 02:00			
15	**Oral presentations** Duration: 02:00			**Individual presentation of a scientific paper related to the course** Continuous assessment Presential Duration: 10:00
16	**Oral presentations** Duration: 02:00			
17				**EvaluacionFinal** Final examination Presential Duration: 03:00

Depending on the programme study plan, total values will be calculated according to the ECTS credit unit as 26/27 hours of student face-to-face contact and independent study time.

* The schedule is based on an a priori planning of the subject; it might be modified during the academic year, especially considering the COVID19 evolution.

7. Activities and assessment criteria

7.1. Assessment activities

7.1.1. Assessment

Week	Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
2	Exercises to be solved individually at home		No Presential	01:00	8%	0 / 10	CB06 CB09 CB10 CG8 CG9 CE1 CE8
4	Exercises to be solved individually at home		No Presential	01:00	8%	0 / 10	CB06 CB09 CB10 CG8 CG9 CE1 CE8
5	Exercises to be solved individually at home		No Presential	01:00	8%	0 / 10	CB06 CB09 CB10 CG8 CG9 CE1 CE8
6	Exercises to be solved individually at home		No Presential	01:00	8%	0 / 10	CB06 CB09 CB10 CG8 CG9 CE1 CE8
7	Questionnaire to be solved individually at home		No Presential	00:30	4%	0 / 10	CB06 CB09 CB10 CG8 CG9 CE1 CE8

8	Exercises to be solved individually at home		No Presential	01:00	8%	0 / 10	CB06 CB09 CB10 CG8 CG9 CE1 CE8
9	Exercises to be solved individually at home		No Presential	01:00	8%	0 / 10	CB06 CB09 CB10 CG8 CG9 CE1 CE8
10	Exercises to be solved individually at home		No Presential	02:00	8%	0 / 10	CB06 CB09 CB10 CG8 CG9 CE1 CE8
11	Exercises to be solved individually at home		No Presential	02:00	8%	0 / 10	CB06 CB09 CB10 CG8 CG9 CE1 CE8
12	Questionnaire to be solved individually at home		No Presential	00:30	4%	0 / 10	CB06 CB09 CB10 CG8 CG9 CE1 CE8
15	Individual presentation of a scientific paper related to the course		Face-to-face	10:00	28%	3 / 10	CB06 CB09 CB10 CG9 CG8 CG9 CE1 CE8

7.1.2. Global examination

Week	Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills

17	EvaluacionFinal		Face-to-face	03:00	100%	0 / 10	CB06 CB09 CB10 CG8 CG9 CE1 CE8

7.1.3. Referred (re-sit) examination

No se ha definido la evaluación extraordinaria.

7.2. Assessment criteria

Assessment criteria for regular attendees:

1. Regular attendance and active participation in classes (10%)

2. Weekly assignments (40%)

3. Final presentation (50%)

Alternatively: Final exam (100%)

8. Teaching resources

8.1. Teaching resources for the subject

Name	Type	Notes
Bibliografia	Bibliography	S.C. Cowin & S. Doty, Tissue Mechanics, Springer, 2007C. Ross Ethier & C.A. Simmons, Introductory Biomechanics, Cambridge University Press, 2008Y. C. Fung, Biomechanics, Motion,
Bibliografia 2	Bibliography	Flow, Stress and Growth, Springer, 1990Y. C. Fung, Biomechanics, Mechanical Properties of Living Tissues, Springer, 1990
Bibliografía	Bibliography	Elices, M., Guinea G.V.; Biological Materials