ANX-PR/CL/001-01

LEARNING GUIDE

SUBJECT

53001233 - Complements Of Materials Strength

DEGREE PROGRAMME

05AZ - Master Universitario En Ingenieria Industrial

ACADEMIC YEAR & SEMESTER

2025/26 - Semester 1

Index

Learning guide

1. Description

1.1. Subject details

Name of the subject	53001233 - Complements Of Materials Strength
No of credits	3 ECTS
Type	Compulsory
Academic year ot the programme	First year
Semester of tuition	Semester 1
Tuition period	September-January
Tuition languages	English
Degree programme	05AZ - Master Universitario en Ingenieria Industrial
Centre	05 - E.T.S. De Ingenieros Industriales
Academic year	2025-26

2. Faculty

2.1. Faculty members with subject teaching role

Name and surname	Office/Room	Email	Tutoring hours *
Ignacio Romero Olleros (Subject coordinator)		ignacio.romero@upm.es	Sin horario.

* 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

- Theory of elasticity

- Structural analysis

- Strength of materials

- Python programming

4. Skills and learning outcomes *

4.1. Skills to be learned

(a) - APLICA. Habilidad para aplicar conocimientos científicos, matemáticos y tecnológicos en sistemas relacionados con la práctica de la ingeniería.

(e) - RESUELVE. Habilidad para identificar, formular y resolver problemas de ingeniería.

(k) - USA HERRAMIENTAS. Habilidad para usar las técnicas, destrezas y herramientas ingenieriles modernas necesarias para la práctica de la ingeniería.

4.2. Learning outcomes

RA105 - Relacionar los desplazamientos y esfuerzos que se producen en una estructura de barras con el sistema de solicitaciones aplicado sobre la misma; teniendo en cuenta que han de satisfacerse las relaciones básicas de Equilibrio, Compatibilidad y Comportamiento.

RA106 - Comprender la sistematización en el cálculo y su implementación en ordenadores como aproximación al uso de esta herramienta en el cálculo de estructuras.

RA104 - Comprender que el Cálculo de Estructuras es una de las fases que conforman el proceso global del proyecto de una estructura; y en ella habrá de determinarse, mediante la aplicación de los Principios de la Mecánica de los Sólidos Deformables, si la estructura podrá desempeñar la función para la que inicialmente fue concebida.

* 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

This is a course designed for students in the Master of Science in Industrial Engineering that have a background in Engineering, but do not have a minor in the mechanical subjects. As such, the goals of the course is to provide a solid understanding of the fundamentals of Stength of Materials and Structural Analysis, and the link it with other branches of Engineering. More specifically, the course will knowingly leave aside traditionally taught skills such as the analytical solution of simple problems and focus on general principles and the computational implementation of solution methods. For that, the main goals of the course are:

- To understand the underlying principles behind structural analysis
- To calculate stress resultants and displacements in 2d structures of bars and beams
- To be able to determine when a structure will withstand given loads or fail
- To learn how to develop a "general purpose" program to calculate structures and use it to design simple ones

5.2. Syllabus

1. Introduction to ASM and structural ana
2. Python: installation and basic notions
3. Basic theory
   - 3.1. Equilibrium
   - 3.2. Compatibility and constitutive relation
   - 3.3. Work and energy
4. Trusses
   - 4.1. Energy
   - 4.2. Resultants
   - 4.3. Stiffness
   - 4.4. Programming
   - 4.5. Stresses: point-by-point calculation
5. Beams
   - 5.1. Energy
   - 5.2. Resultants
   - 5.3. Stiffness
   - 5.5. Stresses: point-by-point calculation
6. Failure
   - 6.1. Elastic limit
   - 6.2. Design

6. Schedule

6.1. Subject schedule*

Week	Type 1 activities	Type 2 activities	Distant / On-line	Assessment activities
1	**Introduction to ASM and structural analysis** Duration: 02:30 Lecture			
2	**Python: installation and basic notions** Duration: 02:30 Lecture			**Assignment 1** Individual work Progressive assessment Not Presential Duration: 02:00 **Short test to assess the assimilation of the material and the preparation of the lecture** Online test Progressive assessment Not Presential Duration: 00:15
3	**Basic theory** Duration: 02:00 Lecture			**Short test to assess the assimilation of the material and the preparation of the lecture** Online test Progressive assessment Not Presential Duration: 00:15
4	**Basic theory** Duration: 02:00 Lecture			**Assignment 2** Group work Progressive assessment Not Presential Duration: 02:00 **Short test to assess the assimilation of the material and the preparation of the lecture** Online test Progressive assessment Not Presential Duration: 00:15
5	**Basic theory** Duration: 02:00 Lecture			**Short test to assess the assimilation of the material and the preparation of the lecture** Online test Progressive assessment Not Presential Duration: 00:15

6	**Trusses** Duration: 02:00 Lecture			**Short test to assess the assimilation of the material and the preparation of the lecture** Online test Progressive assessment Not Presential Duration: 00:15
7	**Trusses** Duration: 02:00 Lecture			**Short test to assess the assimilation of the material and the preparation of the lecture** Online test Progressive assessment Not Presential Duration: 00:15
8	**Trusses** Duration: 02:00 Lecture			**Assignment 3: mid-term project** Group work Progressive assessment Not Presential Duration: 02:00 **Short test to assess the assimilation of the material and the preparation of the lecture** Online test Progressive assessment Not Presential Duration: 00:15
9	**Beams** Duration: 02:00 Lecture			**Short test to assess the assimilation of the material and the preparation of the lecture** Online test Progressive assessment Not Presential Duration: 00:15
10	**Beams** Duration: 02:00 Lecture			**Short test to assess the assimilation of the material and the preparation of the lecture** Online test Progressive assessment Not Presential Duration: 00:15 **Assignment 4** Group work Progressive assessment Not Presential Duration: 02:00
11	**Beams** Duration: 02:00 Lecture			**Short test to assess the assimilation of the material and the preparation of the lecture** Online test Progressive assessment Not Presential Duration: 00:15

12	**Beams** Duration: 02:00 Lecture			**Assignment 5: final project** Group work Progressive assessment Not Presential Duration: 04:00
13	**Failure** Duration: 02:00 Problem-solving class			
14	**Failure** Duration: 02:00 Lecture			
15				
16				
17				

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.

7. Activities and assessment criteria

7.1. Assessment activities

7.1.1. Assessment

Week	Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
2	Assignment 1	Individual work	No Presential	02:00	10%	3 / 10	(a) (e) (k)
2	Short test to assess the assimilation of the material and the preparation of the lecture	Online test	No Presential	00:15	3%	3 / 10	(a) (e)
3	Short test to assess the assimilation of the material and the preparation of the lecture	Online test	No Presential	00:15	3%	3 / 10	(a) (e)
4	Assignment 2	Group work	No Presential	02:00	10%	3 / 10	(a) (e) (k)
4	Short test to assess the assimilation of the material and the preparation of the lecture	Online test	No Presential	00:15	3%	3 / 10	(a) (e)
5	Short test to assess the assimilation of the material and the preparation of the lecture	Online test	No Presential	00:15	3%	3 / 10	(a) (e)
6	Short test to assess the assimilation of the material and the preparation of the lecture	Online test	No Presential	00:15	3%	3 / 10	(a) (e)
7	Short test to assess the assimilation of the material and the preparation of the lecture	Online test	No Presential	00:15	3%	3 / 10	(a) (e)
8	Assignment 3: mid-term project	Group work	No Presential	02:00	20%	3 / 10	(a) (e) (k)
8	Short test to assess the assimilation of the material and the preparation of the lecture	Online test	No Presential	00:15	3%	3 / 10	(a) (e)
9	Short test to assess the assimilation of the material and the preparation of the lecture	Online test	No Presential	00:15	3%	3 / 10	(a) (e)

10	Short test to assess the assimilation of the material and the preparation of the lecture	Online test	No Presential	00:15	3%	3 / 10	(a) (e)
10	Assignment 4	Group work	No Presential	02:00	10%	/ 10	(a) (e) (k)
11	Short test to assess the assimilation of the material and the preparation of the lecture	Online test	No Presential	00:15	3%	3 / 10	(a) (e)
12	Assignment 5: final project	Group work	No Presential	04:00	20%	3 / 10	(a) (e) (k)

7.1.2. Global examination

No se ha definido la evaluacion sólo por prueba final.

7.1.3. Referred (re-sit) examination

Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
Examen en convocatoria extraordinaria	Written test	Face-to-face	02:00	50%	5 / 10	(a) (e) (k)
Trabajo de la asignatura	Individual work	Face-to-face	00:00	50%	5 / 10	(a) (e) (k)

7.2. Assessment criteria

Students at the UPM must be evaluated using a progressive grading system. In this course, the grading will be based on (approximately) weekly assignments, short weekly tests, and two projects. These will be done individually or in groups, as indicated in each case. The final grade of the course will be the average between the overall assignments grade, the tests, and the projects.

Students not following the progressive evaluation will still need to present a project, in addition to the final exam.

8. Teaching resources

8.1. Teaching resources for the subject

Name	Type	Notes
Introduction to mechanics of solids, Popov, E. P	Bibliography	
Mecánica de estructuras. Libro 1, Cervera, M.	Bibliography	
The linearized theory of elasticity, Slaughter, W.	Bibliography	
Mecánica de sólidos (2022), Romero, I.	Bibliography	
Engineering Mechanics of Deformable Solids, Govindjee, S	Bibliography	
Apuntes de la asignatura	Bibliography	Proporcionados en Moodle
Pyris	Others	Código de elementos finitos y análisis estructural desarrollado en python