



## IDENTIFYING DATA

### Elasticity and additional topics in mechanics of materials

Subject	Elasticity and additional topics in mechanics of materials			
Code	V12G363V01603			
Study programme	Grado en Ingeniería en Tecnologías Industriales			
Descriptors	ECTS Credits 6	Choose Mandatory	Year 3rd	Quadmester 2nd
Teaching language	Spanish			
Department				
Coordinator	Riveiro Rodríguez, Antonio			
Lecturers	Barros González, Brais Riveiro Rodríguez, Antonio			
E-mail	ariveiro@uvigo.es			
Web				
General description	<p>This course will study the fundamentals of elasticity and deepen the study of mechanics of materials in order to be able to apply their knowledge to the actual behavior of solids (structures , machinery and resistant elements in general).</p> <p>This course, along with mechanics of materials course, is a holder of more specialized subjects whose object is the mechanical design.</p>			

## Skills

Code	
B3	CG3 Knowledge in basic and technological subjects that will enable them to learn new methods and theories, and equip them with versatility to adapt to new situations.
B4	CG4 Ability to solve problems with initiative, decision making, creativity, critical thinking and to communicate and transmit knowledge, skills and abilities in the field of Industrial Engineering.
C14	CE14 Knowledge and use of the principles of strength of materials.
D2	CT2 Problems resolution.
D5	CT5 Information Management.
D9	CT9 Apply knowledge.
D10	CT10 Self learning and work.
D17	CT17 Working as a team.

## Learning outcomes

Expected results from this subject	Training and Learning Results		
Knowledge of the foundations of the elasticity theory	B3	C14	
Further deepening on mechanics of materials and stress analysis	B3	C14	D2
	B4		D10
Knowledge of deformations in beams and shafts	B3	C14	D2
	B4		D9
Ability to apply the knowledge of elasticity and mechanics of materials, and to analyze the mechanical performance of machines, structures, and general structural elements	B4	C14	D2
			D5
			D9
Ability to take decisions about suitable material, shape and dimensions for a structural element subjected to a specific load	B4	C14	D2
			D5
			D9
			D17

## Contents

Topic	
Fundamentals of elasticity	Introduction to the theory of elasticity Stress analysis of elastic solids Strain Stress-strain relationships Two-dimensional elasticity
Criteria of failure	Saint-Venant's failure criterion Tresca's failure criterion Von-Mises' failure criterion Safety coefficient
Bending	Non uniform bending: Shear stresses. Zhuravski expression Principal stresses. Stress trajectories Bending and axial load: Normal stresses. Neutral axis Eccentric axial loads Kern of the cross-section Beams of different materials
Bending. Statically indeterminate beams	General method Settlements in fixed supports Continuous beams Simplifications in symmetric and antisymmetric beams
Torsion	Definition Coulomb's fundamental theory Static torque diagrams Stress and angle of twist Statically indeterminate problems
Combined loads	Definition Bending and torsion loaded circular shafts Shear center Stress and strain calculation in plane-spatial structures
Strain energy and energy methods	Strain energy: Axial load/shearing loads/bending/torsion/general expression. Clapeyron's theorem Indirect and direct work Maxwell-Betti Reciprocal Theorem. Applications. Castigliano's theorem. Mohr's integrals. Applications. Principle of virtual works.
Trusses	Definition and general comments Degree of indeterminacy Analytical method of force calculation Pinned joint displacement determination External indeterminacy and internal indeterminacy
Structures with rigid joint connections	Definition Joint stiffness factor and distribution factor Degree of indeterminacy. Analysis by the stiffness method.
Moving loads	Influence lines. Definition and general properties.

## Planning

	Class hours	Hours outside the classroom	Total hours
Introductory activities	0.5	0	0.5
Previous studies	0	6	6
Lecturing	13	26	39
Problem solving	18	22	40
Laboratory practical	18	4	22
Autonomous problem solving	0	15	15
Problem and/or exercise solving	2	17.5	19.5
Self-assessment	0	5	5
Laboratory practice	1	2	3

\*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.

<b>Methodologies</b>	
	Description
Introductory activities	Introduction to the subject: Course aims, expected learning outcomes, course syllabus, teaching methods, assessments and grading policy.
Previous studies	<p>Student previous activities to lectures.</p> <p>The students will receive detailed instructions to complete and send certain exercises before lectures/laboratory sessions. The purpose of this assessment is to optimize the session outcome.</p> <p>The delivery of these exercises will modify the obtained qualification of the continuous assessment (laboratory practices and conceptual tests) as explained in the section of "Other comments and second call" in this guide.</p>
Lecturing	<p>The contents of the subject will be presented in a organized way. Special emphasis will be put on the fundamentals of the subject and on the most troublesome points.</p> <p>To improve the comprehension, the contents of the next lectures will be announced on Tema platform on a weekly basis.</p>
Problem solving	Each week will devote a time to the resolution by part of the student of exercises or problems proposed, related with the content studied in each moment.
Laboratory practical	Application of theory concepts to laboratory collaborative works.
Autonomous problem solving	The students will be supplied with exercises and problems to solve, the solutions will be provided for level self-evaluation.

### **Personalized assistance**

<b>Methodologies</b>	<b>Description</b>
Autonomous problem solving	The lecturers are at disposal of the students during office hours to solve any question related to the subject contents. The students will be able to verify if the completed assignments are correct and to identify the mistakes of miscalculations. The detailed schedule will be provided to the students at the beginning of the course through the TEMA platform. Any modification will be previously announced.

### **Assessment**

	Description	Qualification	Training and Learning Results
Previous studies	The delivery of these exercises will modify the obtained qualification of the continuous assessment (laboratory practices and conceptual tests) as explained in the section of "Other comments and second call" in this guide. It shall be deemed completed when a previous activity fully answer all questions.	0	D5 D9 D10 D17
Laboratory practical	<p>Attendance and active participation in the complete laboratory lessons and practice reports will be assessed.</p> <p>They will be graded from 0 to 10, provided that the student gets a minimum mark in the written examination (minimum mark: 4.5/10).</p> <p>The qualification will be modified by the coefficient introduced in the "Other comments and second call" section in this guide.</p>	5	B4 C14 D2 D5 D9 D10 D17
Problem and/or exercise solving	Exam for the assessment of the module learning outcomes. The exam comprises of brief problems and/or theoretical questions.	80	B3 C14 D2 B4 D9
Laboratory practice	<p>The duration and precise grading will be communicated at the beginning of the exam.</p> <p>Short exercises and conceptual tests will be taken during the course (within lecture or laboratory hours; grading from 0 to 10). The mark will be added to the exam mark, provided that the student gets a minimum mark in the written examination (minimum mark: 4.0/10).</p> <p>The qualification will be modified by the coefficient introduced in the "Other comments and second call" section in this guide.</p>	15	B3 D9

### **Other comments on the Evaluation**

In this module the minimum required mark to pass is 5 out of 10.

The written examination of students not able to attend laboratory sessions will be graded 100% of the module mark,

provided the student resigns from continuous assessment (and gets the required school approval) within the period established for that purpose. This examination will assess the subject overall competencies.

The qualification obtained in the laboratory practices in any of the two previous years (5% of the qualification) will be preserved in the current year, provided the student requests that within an established period in the beginning of the course.

The qualification obtained in the conceptual tests in any of the two previous years (15% of the qualification) will be preserved in the current year, provided the student requests that within an established period in the beginning of the course. The rating obtained only remain within the language chosen at the time in which he studied the subject.

Comments about continuous assessment:

The handing of previous exercises (within the established period for each exercise) will modify the qualification of laboratory practices and follow-up conceptual tests as following explained:

Qualification of laboratory practices =  $K \cdot (\text{overall practice grade}) / (\text{nr of laboratory sessions})$

Qualification of conceptual tests =  $K \cdot (\text{addition of tests} \cdot \text{grades}) / (\text{nr of tests})$

$K = (\text{nr of previous exercises delivered}) / (\text{total nr of previous exercises})$

Additional comments:

The absence from a laboratory session, even justified, does not lead to the repetition of the session.

The absence from a test, even justified, does not lead to the repetition of the test.

The date and place of examinations of all calls shall be determined by the center before the start of course and will make them public.

Ethical commitment: it is expected an adequate ethical behaviour of the student. In case of detecting unethical behaviour (copying, plagiarism, unauthorized use of electronic devices, etc.) shall be deemed that the student does not meet the requirements for passing the subject. In this case, the overall rating in the current academic year will be Fail (0.0).

The use of any electronic device for the assessment tests is not allowed unless explicitly authorized. The fact of introducing unauthorized electronic device in the examination room will be considered reason for not passing the subject in the current academic year and will hold overall rating (0.0).

Group responsible lecturer: Groups with teaching in Spanish: Marcos García González and Adrián Pérez Riveiro.

Group with teaching in English: Rafael Comesaña and Antonio Riveiro

Reading list for the group in English:

Recommended:

- Hibbeler R.C., Mechanics of Materials, SI Edition, Prentice Hall. 9th. edition
- José Antonio González Taboada, Tensiones y deformaciones en materiales elásticos, 2a Edición, Tórculo.
- José Antonio González Taboada, Fundamentos y problemas de tensiones y deformaciones en materiales elásticos, 1ª Edición, Tórculo.

Complementary:

- Timoshenko, Goodier, Theory of elasticity, 3rd ed., (International student ed.), McGraw-Hill
- Manuel Vázquez, Resistencia de Materiales.

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### Sources of information

#### Basic Bibliography

José Antonio González Taboada, **Tensiones y deformaciones en materiales elásticos**,

José Antonio González Taboada, **Fundamentos y problemas de tensiones y deformaciones en materiales elásticos**,

Manuel Vázquez, **Resistencia de Materiales**,

#### Complementary Bibliography

Luis Ortiz Berrocal, **Elasticidad**,

Robert Mott, Joseph A. Untener, **Applied Strength of Materials**, 6ª, CRC Press, 2016

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## Recommendations

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### Subjects that it is recommended to have taken before

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Physics: Physics 1/V12G360V01102

Physics: Physics 2/V12G360V01202

Mechanics of materials/V12G360V01404

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### Other comments

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To register for this module the student must have passed or be registered for all the modules of the previous years.

The original teaching guide is written in Spanish. In case of discrepancies, shall prevail Spanish version of this guide.

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## Contingency plan

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### Description

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=== EXCEPTIONAL MEASURES PLANNED ===

Given the uncertain and unpredictable evolution of the health alert caused by COVID-19, the University of Vigo establishes extraordinary planning that will be activated at the time that the administrations and the institution itself determine it based on criteria of safety, health and responsibility , and guaranteeing teaching in a non-classroom or partially classroom setting. These already planned measures guarantee, at the required time, the development of teaching in a more agile and effective way by being known in advance (or well in advance) by students and teachers through the standardized tool and institutionalized teaching guides.

=== ADAPTATION OF THE METHODOLOGIES ===

An attempt will be made to ensure that the degree of presentality in teaching guarantees the safety and health of all parties involved. In any case, the guidelines will be followed in instructions indicated by the management of the center.

In the event that there is a situation in which the teaching activities cannot be attended, neither the content nor the learning results contemplated in the subject will be affected. To this end, the following adaptations will be made.

Theory sessions:

In the event that they cannot be attended, remote classrooms, video recordings of classes, or any other means enabled by the university will be used for delivery. The contents taught will be the same.

Laboratory sessions:

The carrying out of experimental practices will be replaced by non-contact activities to solve similar problems that may require the use of specific calculation / simulation software.

Tutorials:

For the situation of non-attendance, email and, if necessary, videoconference will be used.

Evaluation:

In the event that the tests cannot be carried out in person, they will be carried out by telematic means. The number of assessment tests will not change, nor will the relative weight of each one of them in the course grade.

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