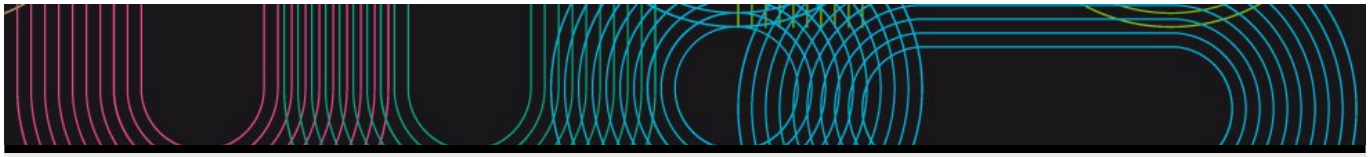

IDENTIFYING DATA				
Resistance of materials				
Subject	Resistance of materials			
Code	P52G381V01204			
Study programme	Grado en Ingeniería Mecánica			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	2nd	1st
Teaching language	Spanish			
Department				
Coordinator	Regueiro Pereira, Araceli			
Lecturers	Regueiro Pereira, Araceli Suárez García, Andrés			
E-mail	regueiro@cud.uvigo.es			
Web	http://moovi.uvigo.gal/			
General description	Introduction to linear elastic materials, and analysis of internal loadings, stress and strain relationships. Study of the fundamentals of mechanics of materials and particularization for shafts and beam structures.			

Skills	
Code	
B3	Knowledge in basic and technological subjects that will enable students to learn new methods and theories, and provide them the versatility to adapt to new situations.
B4	Ability to solve problems with initiative, decision making, creativity, critical thinking and the ability to communicate and transmit knowledge and skills in the field of Industrial Engineering in Mechanical specialty.
C14	Knowledge and use of the principles of strength of materials.
D1	Analysis and synthesis
D2	Problems resolution.
D9	Apply knowledge.
D10	Self learning and work.
D16	Critical thinking.
D17	Working as a team.

Learning outcomes			
Expected results from this subject	Training and Learning Results		
Know the differences between rigid and elastic solids.	B3 B4	C14	D1 D2 D9 D10 D16 D17
Apply the acquired knowledge to maximum stress calculation at a point in a deformable solid.	B3 B4	C14	D1 D2 D9 D10 D16 D17
To know the basic principles governing Strength of Materials.	B3 B4	C14	D1 D2 D9 D10 D16 D17

To know the relationships between the different stresses and the stresses they cause.	B3 B4	C14	D1 D2 D9 D10 D16 D17
Apply the acquired knowledge to the determination of stresses.	B3 B4	C14	D1 D2 D9 D10 D16 D17
Apply the acquired knowledge of stresses to their estimation in bar elements.	B3 B4	C14	D1 D2 D9 D10 D16 D17
To know the fundamentals of the deformations of bar elements.	B3 B4	C14	D1 D2 D9 D10 D16 D17
Apply the knowledge acquired to the dimensioning of busbar elements.	B3 B4	C14	D1 D2 D9 D10 D16 D17
ENAEE LEARNING OUTCOME: KNOWLEDGE AND UNDERSTANDING. LO 1.2: Knowledge and understanding of the engineering disciplines specific to their speciality, at the level necessary to acquire the rest of the competences of the degree, including notions of the latest developments. Level of development: Adequate (2). NOTE: The possible values for the level of development are: Basic (1), Adequate (2) and Advanced (3).	B3	C14	
ENAEE LEARNING OUTCOME: ENGINEERING ANALYSIS. LO 2.2: The ability to identify, formulate and solve engineering problems in their speciality; to choose and apply established analytical, computational and experimental methods appropriately; to recognise the importance of social, health and safety, environmental, economic and industrial constraints. Level of development: Adequate (2).	B4		D1 D2 D9 D16
ENAEE LEARNING OUTCOME: RESEARCH AND INNOVATION. LO 4.3: Ability and skill to plan and carry out experimental research, interpret results and reach conclusions in their field of study. Level of development: Basic (1).		C14	D9

Contents	
Topic	
Topic 1. Statics	- Concept of the elastic solid - Vector. Dot Product and Cross Product - Moment of a force - Static balance. Equations - Moments and products of inertia - Static balance and elastic balance - Requests on a section in elastic regime
Topic 2. Basic concepts of Strength of Materials	-Object and purpose of strength of materials - Tensions and deformations. - Tension state. Stress matrix. Mohr's circle - Principle of relative stiffness and superposition - Elastic balance - Reactions in ligatures. Types of supports - Isostatic and hyperstatic systems - Security coefficient. Admissible tension
Topic 3. Traction-Compression	- Normal effort - Tensile deformations - Statically determinate problems - Hyperstatic problems - Monoaxial traction or compression caused by thermal variations or assembly defects

Topic 4. Fundamentals of buckling	- Definition - Critical load. Euler's formulation - Application limits of the Euler formulations
Topic 5. Bending and shear	- Beams. Deformation and classes. Forces applied to beams - Shear stress and bending moment - Relations between shear stress, bending moment and load - Diagram of shear forces and bending moments - Types of bending. Assumptions and limitations - Normal tensions. Navier's Law - Concept of resistant module. Optimum sections - Analysis of deformations: turns and arrows. Moment-curvature relationship. Elastic equation. Theorems for the calculation of deformations - Hyperstatic flexion
Topic 6. Failure criteria	- Limit state - Ductile material - Fragile material - Security factor
Laboratory Session 1: Tensile test	The student will play with tensile test, as well as the normative that describe them.
Laboratory Session 2: F-Tool software practice (I)	The student will calculate tensile and shear stress values in different assumptions by using a structural calculation software.
Laboratory Session 3: Compression test	The student willl play with compression test, as well as the normative that describe them. You will make different more and less slender prototypes and calculate the critical force. The grip must be the same for all of them, implying a sudden change of section. The normal stress diagram will also be calculated.
Laboratory Session 4: Shear test	The student willl play with shear test, as well as the normative that describe them.
Laboratory Session 5: Bending test	The student willl play with bending test, as well as the normative that describe them. Analyze different configurations: bi-embedded, bi-articulated and bi-supported beam. Calculate the bending moment and the deflection associated with each of them.
Laboratory Session 6: Modulus of elasticity	This practice will focus on the calculation of the experimental modulus of elasticity. The student will use the data collected by the student in the previous laboratory sessions. For this, the association of the elastic modulus and the tensions in each test carried out will be reviewed.
Laboratory Session 7: F-Tool software practice (II)	Student will analyze bar structures of increasing complexity, obtaining tensile, shear and bending stresses, as well as the deformation under different types of load.

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	28	28	56
Laboratory practical	14	14	28
Seminars	7	0	7
Essay questions exam	13	26	39
Laboratory practice	15	5	20

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

Methodologies

	Description
Lecturing	In lectures, the fundamentals of each topic are explained. Students will have the slides of the lectures at their dispossal
Laboratory practical	In laboratory sessions, the concepts taught in lectures will be applied. A series of practices have been designed to show the concepts explained in lectures and develop the student ability to propose technical solutions.
Seminars	In the seminars, a series of problems are analysed and proposed to be carried out. Students must solve exercises and problems under the supervision of the lecturer

Personalized assistance

Methodologies	Description

Lecturing	In the personalized assistance, a distinction is made between academic and personalised assessment. In the academic assessment, students will have at their disposal tutoring sessions in which they can ask any question related to the contents, organisation and planning of the subject. In the personalised assessment, each student, individually, will be able to discuss with the lecturer any problem that is preventing him/her from following the course properly, in order to find some kind of solution between them. By combining both types of assessment, the aim is to compensate for the different learning rhythms through attention to diversity. Both will be scheduled by appointment

Assessment

	Description	Qualification	Training and Learning Results		
Essay questions exam	Final Test (PF) which represents 40% of the continuous assessment (EC). 2 Theoretical-Practical Controls (PT) representing: 2x15%=30% of EC.	70	B3 B4	C14	D1 D2 D9 D10 D16
Laboratory practice	Practice Reports (PL) which represent 20% of the EC. Questionnaires and Tests (CT) representing 10% of EC.	30	B3 B4	C14	D1 D2 D9 D16 D17

Other comments on the Evaluation

Continuous assessment

The continuous assessment (EC) method will assess the results achieved by students in the different activities carried out throughout the course, grouped into four parts: Final Exam (PF), Theoretical-Practical Controls (PT), Laboratory Practices (PL) and Deliverable Reports (PE). The weights for each part will be: PF 40 %, PL 30 %, PE 20 % and CT 10 %.

There will be two evaluation controls of theoretical-practical knowledge (PT1 and PT2) throughout the course. Each of them will account for 15 % of the final continuous assessment mark. These controls will be interspersed with the theory sessions. The PT FINAL grade will be the arithmetic mean of PT1 and PT2.

The student will be assessed for each laboratory session carried out (PL1 to PL7). Each practice will account for 3% of the final continuous assessment grade, except for PL2 and PL7, which will be 2.5%. This evaluation will be carried out by reports or questionnaires. It could be the case that a report and a questionnaire could be requested simultaneously for the assessment of a single session. The delivery of the reports and the completion of the questionnaires will be carried out telematically through the MOOVI platform. In addition, during seminar and/or theory class hours, students will be asked to complete and submit different exercises (PE).

The final continuous assessment test (PF) will include all the contents of the subject and will have a weight of 40% in the final continuous assessment mark.

The continuous assessment mark (NEC) will be the result of applying the weighted arithmetic average of the marks for each of the parts (PF, PT, PL and PE), as shown in the following equation:

$NEC=0.4\ PF+0.3\ PT+0.2\ PL+0.1\ CT$

In order to pass the continuous assessment, two conditions must be met: having a $NEC \geq 5$ and a $PF \geq 4$. If the latter condition is not met, the PL grade will be ignored, and the student will obtain a failing grade in the continuous assessment of the subject, with a score equal to the minimum of 4.0 and the weighted average of PF and PT.

Ordinary exam

Those students who do not manage to pass the subject by the continuous assessment method must do the ordinary exam, where all the competences of the subject will be assessed. The results of this exam will account for 100% of the student's final mark. A mark greater than 5 is a requirement for passing the course. Finally, it is worth highlighting that all students have the option to raise their NEC. In other words, students who have passed the subject by continuous assessment will have the possibility of taking the ordinary exam to improve their mark.

Extraordinary exam

Students who have not passed the course in the ordinary exam will sit an extraordinary exam which will have the same format and the same requirements as the ordinary exam.

Ethical commitment

As both a member of the military and a student of the University of Vigo, the student is subject to the obligations derived from both institutions. As far as university students are concerned, the University Student Statute, approved by Royal Decree 1791/2010 of 30 December, establishes in article 12, point 2d, that university students have the duty to "refrain from using or cooperating in fraudulent procedures in assessment tests, in the work carried out or in official university documents". Likewise, the Law 39/2007 on Military Careers, in its article 4 concerning the rules of behaviour of the military, states in its fifteenth rule that the military "shall perform their duties and obligations with accuracy, motivated by a sense of honour, [...]".

Therefore, the student is expected to behave ethically. If unethical behaviour is detected during the course (cheating, plagiarism, use of unauthorised electronic devices or other), the student will be penalised with a grade of "0.0" on the written test or deliverable and will have an NEC of "0.0" at the end of the term.

Sources of information

Basic Bibliography

Ortiz Berrocal, Luis, **Resistencia de Materiales**,

Complementary Bibliography

Hibberler, R.C., **Mecánica de materiales**,

Ferdinand P. Beer, E. Russel Johnson, JR., David F. Mazurek & Elliot R. Eisenberg, **Mecánica vectorial para ingenieros**,

Recommendations

Other comments

The subject Strength of Materials is the study of the behaviour of real materials in relation to their strength, stiffness and stability. This course requires the necessary conceptual basis for its correct understanding. For this reason, in order to successfully complete it, the student must have:

- Ability of written and oral comprehension.

- Ability of abstraction, basic calculation and synthesis of information.