UNIVERSIDAD DE CASTILLA - LA MANCHA

GUÍA DOCENTE

1. General information

Course:	SOLID MECHANICS	**Code:**	38322
Type:	CORE COURSE	**ECTS credits:**	6
Degree:	345 - UNDERGRADUATE DEGREE PROGRAMME IN CIVIL ENGINEERING	**Academic year:**	2023-24
Center:	603 - E.T.S. CIVIL ENGINEERS OF CR	**Group(s):**	20
Year:	3	**Duration:**	First semester
Main language:	Spanish	**Second language:**	
Use of additional languages:		**English Friendly:**	Y
Web site:		**Bilingual:**	N

Lecturer: **EDUARDO WALTER VIEIRA CHAVES** - Group(s): **20**

Building/Office	Department	Phone number	Email	Office hours
D55	MECÁNICA ADA. E ING. PROYECTOS	6312	eduardo.vieira@uclm.es	Any working day after 18h.

2. Pre-Requisites

Engineering Mathematics I (38300); Engineering Mathematics II (38305)

3. Justification in the curriculum, relation to other subjects and to the profession

Understanding the behavior of deformable bodies and material science by means of theoretical models (e.g. solid mechanics, fluid mechanics).

Apply these models to particular cases and use them to predict mechanical phenomena.

The student learning as a result of the course, understands and dominates the governing equations of practical problems in engineering, thus providing a critical point of view when adopting an approach in order to solve a particular physical problem.

4. Degree competences achieved in this course

Course competences

Code	Description
CE07	Students reach understanding and mastery of the basic concepts on the general laws of mechanics, thermodynamics, fields and waves and electromagnetism and their application for the solution of engineering problems.

5. Objectives or Learning Outcomes

Course learning outcomes

Description

Students understand the behavior of bodies and materials through theoretical models (material point, rigid solid body, deformable solid body). They apply these models to specific cases and use them to predict mechanical phenomena.

Additional outcomes

The student, as learning results, understands and masters the governing equations of practical problems in engineering, thus providing a critical point of view at the time of adopting approaches for the established problem.

6. Units / Contents

Unit 1: Tensors and Tensor Fields

Unit 1.1 Vectors. Coordinate System. Indicial notation. Higher-order tensors: dyad, tensor algebraic operations, transpose, cofactor of a tensor, tensor determinant, inverse of a tensor. Tensor transformation law. Eigenvalues and eigenvectors of a tensor. Orthogonality. Invariants of the tensor. Spectral representation of a tensor. Cayley Hamilton theorem. Isotropic and anisotropic tensors. Polar decomposition. Spherical and deviatoric tensors. Voigt notation. Graphical representation of the tensor: Mohr Circle, tensor ellipsoid. Haigh-Wetergaard space.

Unit 1.2 Tensor Fields. Differential Operators: Divergence; Gradient; Curl. Properties of differential operators. Differential Operators compounds. Theorems involving Integrals.

Unit 2: Stress Tensor

Unit 2.3 Forces. Traction vector. Stress tensor. Relationship between the traction vector and the stress tensor. Equilibrium equations. Symmetry of the Cauchy stress tensor. Mohr Circle in Stress. Stress state in two-dimensional case.

Unit 3: Continuum Kinematics

Unit 3.1 The continuum medium: Description of motion: spatial (Eulerian) and material (Lagrangian) descriptions. Deformation Gradient. Finite deformation tensors. Deformation of area and volume. Particular types of motion. Infinitesimal deformation regime.

Unit 4: Fundamental Equations of Continuum Mechanics

Unit 4.2 Principle of conservation of mass. Principle of conservation of linear momentum. Principle of conservation of angular momentum. Principle of

conservation of energy. Principle of Irreversibility.

Unit 5: Introduction to Contitutive Equations

Unit 5.1 The Constitutive Principles: Determinism; Local action; Equipresence; Objectivity; Dissipation. Constitutive equations for solids: classical elasticity; Hookean material. Constitutive equations for fluids. Newtonian fluid.

Unit 6: Initial Boundary Value Problem - IBVP

Unit 6.1 Thermo-mechanical problem, heat conduction problem, rigid body problem, Linear elasticity problem.

7. Activities, Units/Modules and Methodology

Training Activity	Methodology	Related Competences (only degrees before RD 822/2021)	ECTS	Hours	As	Com	Description
Class Attendance (theory) [ON-SITE]	Combination of methods	CE07	1.3	32.5	N	-	
Problem solving and/or case studies [ON-SITE]	Problem solving and exercises	CE07	0.4	10	Y	N	
Final test [ON-SITE]	Assessment tests	CE07	0.3	7.5	Y	Y	
Study and Exam Preparation [OFF-SITE]	Self-study	CE07	3.6	90	N	-	
Mid-term test [ON-SITE]	Assessment tests	CE07	0.4	10	Y	N	
		Total:	**6**	**150**			
		Total credits of in-class work: 2.4					**Total class time hours: 60**
		Total credits of out of class work: 3.6					**Total hours of out of class work: 90**

As: Assessable training activity
Com: Training activity of compulsory overcoming (It will be essential to overcome both continuous and non-continuous assessment).

8. Evaluation criteria and Grading System

Evaluation System	Continuous assessment	Non-continuous evaluation*	Description
Mid-term tests	28.00%	0.00%	First test (Topics: 1 and 2) - the exam can be retaken in the ordinary exam
Mid-term tests	28.00%	0.00%	Second test (Topics: 3 and 4) - the exam can be retaken in the ordinary exam
Mid-term tests	27.00%	0.00%	Third test (Topics: 5 and 6) - the exam can be retaken in the ordinary exam
Assessment of problem solving and/or case studies	17.00%	0.00%	Problems solved in class - irrecoverable
Final test	0.00%	100.00%	
Total:	**100.00%**	**100.00%**	

According to art. 4 of the UCLM Student Evaluation Regulations, it must be provided to students who cannot regularly attend face-to-face training activities the passing of the subject, having the right (art. 12.2) to be globally graded, in 2 annual calls per subject , an ordinary and an extraordinary one (evaluating 100% of the competences).

Evaluation criteria for the final exam:

Continuous assessment:

The evaluation opportunities throughout the course will be three, two of which will have the final exams (ordinary and extraordinary) and the third "the evaluation per course".
The exam grades are not saved for the next academic year.
The Assessment by Course
The evaluation per course consists of 4 notes. The first three correspond to three written exams scored from 0 to 10 points, being necessary to achieve a minimum of 4.0 in each one of them in order to pass the subject per course (partial). The fourth note corresponds to continuous evaluation, i.e. to the activity developed by the student in class and evaluated by the teacher.
The student will pass the subject per course when the average of the 4 notes is equal to or greater than 5.0.
The Ordinary Exam
In the final exam of the ordinary call students can choose to examine only those parts that are not compensated (i.ie. when the mark of the partial is <4.0).

Non-continuous evaluation:

The evaluation consists of a single test related to the whole subject.

The student can also be able to do the partial exams. So, at the time of the ordinary exam, it is enough to do the not compensated exam (mark <4). And the compensated exam mark is saved here.

Note:
Unless stated otherwise, continuous evaluation criteria will be applied to all students.
Anyone choosing non-continuous assessment must notify it to the lecturer within the class period of the subject. The option is only available if the student¿s participation in evaluation activities (from the continuous assessment) has not reached 50% of the total evaluation for the subject.
For the retake exam, the assessment type used for the final exam will remain valid.

Specifications for the resit/retake exam:

Same % as for the final exam for both continuous and non-continuous evaluation except for the exam on the continuous assessment in which the evaluation system remains.

Specifications for the second resit / retake exam:

The evaluation consists of a single test related to the whole subject being necessary to achieve the average of 5.0 in order to pass the subject.

9. Assignments, course calendar and important dates

Not related to the syllabus/contents

Hours	hours
Final test [PRESENCIAL][Assessment tests]	5
Unit 1 (de 6): Tensors and Tensor Fields	
Activities	**Hours**
Class Attendance (theory) [PRESENCIAL][Combination of methods]	12
Problem solving and/or case studies [PRESENCIAL][Problem solving and exercises]	6
Study and Exam Preparation [AUTÓNOMA][Self-study]	25.5
Unit 2 (de 6): Stress Tensor	
Activities	**Hours**
Class Attendance (theory) [PRESENCIAL][Combination of methods]	5
Problem solving and/or case studies [PRESENCIAL][Problem solving and exercises]	2.5
Study and Exam Preparation [AUTÓNOMA][Self-study]	10.6
Unit 3 (de 6): Continuum Kinematics	
Activities	**Hours**
Class Attendance (theory) [PRESENCIAL][Combination of methods]	10
Problem solving and/or case studies [PRESENCIAL][Problem solving and exercises]	5
Study and Exam Preparation [AUTÓNOMA][Self-study]	21.25
Unit 4 (de 6): Fundamental Equations of Continuum Mechanics	
Activities	**Hours**
Class Attendance (theory) [PRESENCIAL][Combination of methods]	7
Problem solving and/or case studies [PRESENCIAL][Problem solving and exercises]	3.5
Study and Exam Preparation [AUTÓNOMA][Self-study]	14.9
Unit 5 (de 6): Introduction to Contitutive Equations	
Activities	**Hours**
Class Attendance (theory) [PRESENCIAL][Combination of methods]	2
Problem solving and/or case studies [PRESENCIAL][Problem solving and exercises]	1
Study and Exam Preparation [AUTÓNOMA][Self-study]	4.3
Unit 6 (de 6): Initial Boundary Value Problem - IBVP	
Activities	**Hours**
Class Attendance (theory) [PRESENCIAL][Combination of methods]	4
Problem solving and/or case studies [PRESENCIAL][Problem solving and exercises]	2
Study and Exam Preparation [AUTÓNOMA][Self-study]	8.45
Global activity	
Activities	**hours**
Class Attendance (theory) [PRESENCIAL][Combination of methods]	40
Study and Exam Preparation [AUTÓNOMA][Self-study]	85
Problem solving and/or case studies [PRESENCIAL][Problem solving and exercises]	20
Final test [PRESENCIAL][Assessment tests]	5
	Total horas: 150

10. Bibliography and Sources

Author(s)	Title/Link	Publishing house Citv	ISBN	Year	Description
Chaves, Eduardo W. V.	Mecánica del Medio Continuo: Problemas resueltos	CIMNE	978-84-943307-5-9	2014	
Chaves, Eduardo W. V.	Mecánica del medio continuo : (conceptos básicos)	CIMNE	978-84-96736-38-2	2007	
Chaves, Eduardo W. V.	Mécanica del medio continuo : modelos constitutivos	CIMNE	978-84-96736-68-9	2009	
Chaves, Eduardo W. V.	Notes on Continuum Mechanics	CIMNE/Springer	978-94-007-5985-5	2013	
	http://link.springer.com/book/10.1007%2F978-94-007-5986-2				
Chandrasekharaiah, D. S.	Continuum mechanics	Academic Press	0-12-167880-6	0	
Gurtin, Morton E.	An introduction to continuum mechanics	Academic Press	0-12-309750-9	1981	
Holzapfel, Gerhard A.	Nonlinear solid mechanics : a continuum approach for enginee	John Wiley & Sons	0-471-82319-8	2000	
Chadwick, Peter	Continuum mechanics : concise theory and problems	Dover	0-486-40180-4	1999	
Lai, Michae W. (1930)	Introduction to continuum mechanics	Butterworth-Heinemann	978-0-7506-8560-3	2010	
MASE, George E.	Teoría y problemas de mecánica del medio continuo	McGraw-Hill	0-07-091668-3	1977	
Malvern, Lawrence E.	Introduction to the mechanics of a continuous medium	Prentice-Hall	0-13-487603-2	1969	
Oliver, J. (Javier Oliver Olivella)	Mecánica de medios continuos para ingenieros	UPC	84-8301-412-2	2000	
Spencer, A.J.M.	Continuun mechanics	Dover	0-486-43594-6	1980	