

**1. General information****Course:** DYNAMIC MATERIALS AND STRUCTURES**Type:** ELECTIVE**Degree:** 2343 - MASTERS DEGREE PROGRAMME IN ENGINEERING OF ROADS, CANALS AND PORTS**Center:** 603 - E.T.S. CIVIL ENGINEERS OF CR**Year:** 2**Main language:** English**Use of additional languages:****Web site:****Code:** 310812**ECTS credits:** 4.5**Academic year:** 2021-22**Group(s):** 20**Duration:** First semester**Second language:** Spanish**English Friendly:** N**Bilingual:** N**Lecturer:** GONZALO FRANCISCO RUIZ LOPEZ - Group(s): 20

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2. Pre-Requisites

It is recommended that the students have knowledge of the following subjects:

Continuum Mechanics and Materials Science, Rigid Body Mechanics, Solid Mechanics, Science and Technology of Civil Engineering Materials, Strength of Materials

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

Not established

4. Degree competences achieved in this course**Course competences**

Code	Description
AFC1	Ability to address and solve advanced mathematical engineering problems, from problem solving to formulation development and implementation in a computer program. In particular, the ability to formulate, program and apply advanced analytical and numerical models for calculation, design, planning and management, as well as the ability to interpret the results obtained, in the context of civil engineering.
G27	Ability to communicate in a second language.
G29	Management capacity and teamwork.
ICET1	Theoretical and practical knowledge of the behaviour of materials, structural elements and structures through constitutive models. Ability to apply these models to specific cases and use them to predict mechanical phenomena.
ICET2	Theoretical and practical knowledge of the dynamic behaviour of materials, structural elements and structures. Ability to apply these models to specific cases and use them to predict mechanical phenomena.
ICET4	Capacity for dynamic analysis of structures and determination of the main characteristics that define their dynamic response. Knowledge of the actions that generate a dynamic response in structures and the ability to carry out an effective structural design in the face of dynamic actions.
TE02	Knowledge and capacity for structural analysis through the application of methods and programmes for the design and advanced calculation of structures, based on the knowledge and understanding of loads and their application to structural typologies in civil engineering. Ability to perform structural integrity assessments.
TE03	Knowledge of all types of structures and their materials, and ability to design, project, execute and maintain civil engineering structures and buildings.

5. Objectives or Learning Outcomes**Course learning outcomes****Description**

Students can identify and solve structural problems.

Students can calculate and design technologically each of the elements of the structure according to the materials and typology chosen to solve the structural problem.

Students understand the dynamic behavior of materials, structural elements and structures. They apply these models to specific cases and use them to predict mechanical phenomena.

Students can numerically model the dynamic behavior of structures, determining the main characteristics that define their dynamic response.

Students use computer programs that simulate the mechanical behavior of materials and structures in static and dynamic regimes.

Students know the actions that generate a dynamic response in the structure and can perform an effective structural design in response to dynamic actions.

6. Units / Contents

Unit 1: Dynamic behavior of materials in Civil Engineering

Unit 1.1 Material behavior in dynamic regime

Unit 1.2 Constitutive models in dynamic regime

Unit 1.3 Linear elastic fracture mechanics in dynamic regime

Unit 1.4 Cohesive fracture in dynamic regime

Unit 2: Digital signal processing

Unit 2.1 Analog and digital signals. Linear systems

Unit 2.2 Time response: convolution; discrete Fourier Transformation; FFT

Unit 3: Digital signal processing applied to structural dynamics

Unit 3.1 Dynamic load decomposition

Unit 3.2 Mode and spectral analysis

Unit 3.3 Harmonic analysis

Unit 3.4 Transitory analysis

Unit 4: Fatigue of structures under cyclic loading

Unit 5: Lab practice

Unit 5.1 Fracture of concrete under impact loading through a drop weight device

Unit 5.2 Modelling of the fatigue of a structural element under cyclic loading

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]	Lectures	AFC1 G27 ICET1 ICET2 ICET4 TE02 TE03	0.95	23.75	N	-	
Class Attendance (practical) [ON-SITE]	Project/Problem Based Learning (PBL)	AFC1 TE02 TE03	0.15	3.75	N	-	
Practicum and practical activities report writing or preparation [OFF-SITE]	Cooperative / Collaborative Learning	G29 TE02 TE03	0.25	6.25	Y	Y	The report consists of two parts, experimental and numerical, a minimum note of 4 is required. It is recoverable with a new submission.
Laboratory practice or sessions [ON-SITE]	Combination of methods	AFC1 G29 TE02 TE03	0.25	6.25	Y	N	Can be recovered in the final exam. The class performance in the case of continuous evaluation forms 10% of the global note.
Study and Exam Preparation [OFF-SITE]	Combination of methods	AFC1 G29 TE02 TE03	2.9	72.5	N	-	
Total:			4.5	112.5			
Total credits of in-class work: 1.35			Total class time hours: 33.75				
Total credits of out of class work: 3.15			Total hours of out of class work: 78.75				

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
Final test	50.00%	60.00%	In order to pass, the final test (TE) needs to have a minimum note of 4.
Practicum and practical activities reports assessment	15.00%	15.00%	Lab practice and lab report (EP) consist of both numerical and experimental parts. A minimum note of 4 is needed to pass.
Assessment of active participation	10.00%	0.00%	Class performance (AC).
Assessment of problem solving and/or case studies	25.00%	25.00%	Problem solving and case studies with finite element software (TC).
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:

- 1) Minimum requirements: ET, EP ≥ 4 .
- 2) Global evaluation: $0.50 \cdot ET + 0.15 \cdot EP + 0.10 \cdot AC + 0.25 \cdot TC$
- 3) No notes will be kept for the next academic year.

Non-continuous evaluation:

By default, all students will be under continuous assessment. Whoever chooses for the non-continuous evaluation should inform the instructor before the class period ends and can only do so if his or her participation in the evaluable activities (according to the continuous assessment) will not reach 50% of the subject.

- 1) Minimum requirements: ET, EP ≥ 4 .
- 2) Global evaluation: $0.60 \cdot ET + 0.15 \cdot EP + 0.25 \cdot TC$
- 3) No notes will be kept for the next academic year.

Specifications for the resit/retake exam:

In the retake exam, each student will be evaluated in the same (continuous or non-continuous) manner as in the normal exam. The same weights and minimum note requirements will be applied. No evaluation will be carried to the next academic year.

Specifications for the second resit / retake exam:

The same criterion as that of the non-continuous evaluation applies.

9. Assignments, course calendar and important dates	
Not related to the syllabus/contents	
Hours	hours
Unit 1 (de 5): Dynamic behavior of materials in Civil Engineering	
Activities	Hours
Class Attendance (theory) [PRESENCIAL][Lectures]	5.75
Study and Exam Preparation [AUTÓNOMA][Combination of methods]	18
Teaching period: two weeks	
Group 20:	
Initial date: 13-09-2021	End date: 24-09-2021
Unit 2 (de 5): Digital signal processing	
Activities	Hours
Class Attendance (theory) [PRESENCIAL][Lectures]	6
Study and Exam Preparation [AUTÓNOMA][Combination of methods]	18
Teaching period: two weeks	
Group 20:	
Initial date: 27-09-2021	End date: 08-10-2021
Unit 3 (de 5): Digital signal processing applied to structural dynamics	
Activities	Hours
Class Attendance (theory) [PRESENCIAL][Lectures]	6
Study and Exam Preparation [AUTÓNOMA][Combination of methods]	18
Teaching period: two and a half weeks	
Group 20:	
Initial date: 11-10-2021	End date: 05-11-2021
Unit 4 (de 5): Fatigue of structures under cyclic loading	
Activities	Hours
Class Attendance (theory) [PRESENCIAL][Lectures]	6
Study and Exam Preparation [AUTÓNOMA][Combination of methods]	18.5
Teaching period: two weeks	
Group 20:	
Initial date: 08-11-2021	End date: 19-11-2021
Unit 5 (de 5): Lab practice	
Activities	Hours
Class Attendance (practical) [PRESENCIAL][Project/Problem Based Learning (PBL)]	3.75
Practicum and practical activities report writing or preparation [AUTÓNOMA][Cooperative / Collaborative Learning]	6.25
Laboratory practice or sessions [PRESENCIAL][Combination of methods]	6.25
Teaching period: two weeks	
Group 20:	
Initial date: 22-11-2021	End date: 03-12-2021
Global activity	
Activities	hours
Class Attendance (theory) [PRESENCIAL][Lectures]	23.75
Practicum and practical activities report writing or preparation [AUTÓNOMA][Cooperative / Collaborative Learning]	6.25
Class Attendance (practical) [PRESENCIAL][Project/Problem Based Learning (PBL)]	3.75
Laboratory practice or sessions [PRESENCIAL][Combination of methods]	6.25
Study and Exam Preparation [AUTÓNOMA][Combination of methods]	72.5
Total horas: 112.5	

10. Bibliography and Sources					
Author(s)	Title/Link	Publishing house	Citv	ISBN	Year Description
Sidney Mindess, J. Francis	Concrete	Prentice Hall		0130646326	2002
Young and David Darwin					
Steven W. Smith	Scientist and Engineer's Guide to Digital Signal Processing http://www.dspguide.com	Betrams		0966017633	1997
X.X. Zhang, G. Ruiz & R.C. Yu	A New Drop-weight Impact Machine for Studing Fracture Process in Structural Concrete http://onlinelibrary.wiley.com/doi/10.1111/j.1475-1305.2008.00574.x/abstract?systemMessage=Wiley+Online+Library+disruption+has+been+delayed+to+the+12th+July+2015.+We+will+provide+a+further+update+as+soon+as+possible	Blackwell Publishing Ltd.	Londres	1475-1305	2010 Se trata de una torre caída de diseño propio en la ETSI de Caminos, Canales y Puertos en la UCLM, Ciudad Real
	Concrete Structures under Impact and Impulsive Loading -Synthesis Report	CEB Bulletins			1988
Anil K. Chopra	Dynamics of Structures	Prentice Hall International Series in Civil Engineering and Engineering Mechanics		0132858037	2011 4th Edition, ISBN-13: 978-0132858038
CEB-FIB Model	Fatigue of Concrete Structures - State-of-				

