

# ANX-PR/CL/001-01

## LEARNING GUIDE

### SUBJECT

**43000441 - Advanced Analysis And Design Of Concrete Structures**

### DEGREE PROGRAMME

04AM - Master Universitario Ingenieria De Estructuras, Cimentaciones Y Materiales

### ACADEMIC YEAR & SEMESTER

2022/23 - Semester 2

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## 1. Description

### 1.1. Subject details

<b>Name of the subject</b>	43000441 - Advanced Analysis And Design Of Concrete Structures
<b>No of credits</b>	4.5 ECTS
<b>Type</b>	Optional
<b>Academic year of the programme</b>	First year
<b>Semester of tuition</b>	Semester 2
<b>Tuition period</b>	February-June
<b>Tuition languages</b>	English
<b>Degree programme</b>	04AM - Master Universitario Ingenieria de Estructuras, Cimentaciones y Materiales
<b>Centre</b>	04 - Escuela Tecnica Superior De Ingenieros De Caminos, Canales Y Puertos
<b>Academic year</b>	2022-23

## 2. Faculty

### 2.1. Faculty members with subject teaching role

<b>Name and surname</b>	<b>Office/Room</b>	<b>Email</b>	<b>Tutoring hours *</b>
Alejandro Perez Caldentey	Lab. Estruct	alejandro.perezc@upm.es	F - 16:00 - 20:00
Hugo Eduardo Corres Peiretti (Subject coordinator)	Lab. Estruct.	hugoeduardo.corres@upm.es	F - 16:00 - 20:00
Fco.javier Leon Gonzalez	Lab. Estruct	franciscojavier.leon@upm.es	Th - 16:00 - 20:00 F - 16:00 - 20:00

\* 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

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#### 3.1. Recommended (passed) subjects

The subject - recommended (passed), are not defined.

#### 3.2. Other recommended learning outcomes

- Structural analysis. Computer Science. Prestressed and reinforced concrete. Concrete and steel structures

### 4. Skills and learning outcomes \*

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#### 4.1. Skills to be learned

CB10 - Que los estudiantes posean las habilidades de aprendizaje que les permitan continuar estudiando de un modo que habrá de ser en gran medida autodirigido o autónomo.

CE12 - Capacidad para el ejercicio profesional de alta especialización o para la investigación predoctoral mediante la utilización de recursos de modelización predictiva en Análisis y diseño de estructuras de hormigón y de acero..

CT3 - Compromiso y capacidad de aplicación de los estándares de deontología en investigación y ejercicio profesional avanzado

#### 4.2. Learning outcomes

RA42 - Knowledge of the nonlinear behaviour of concrete structures based on the interpretation of the experimental results available.

\* 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

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### 5.1. Brief description of the subject

Advanced analysis and design of concrete structures, including nonlinear behavior both at ULS and SLS, Strut-and-Tie Method as well as specific subjects as prestressing, fire behavior and fibre reinforced concrete

### 5.2. Syllabus

#### 1. Material nonlinear behaviour

- 1.1. Differences between behaviour, analysis and design criteria
- 1.2. Experimental results and available criteria
- 1.3. Constitutive equations. Moment-curvature diagrams
- 1.4. Nonlinear analysis

#### 2. Slender elements

- 2.1. Material and geometric nonlinearity. General concepts
- 2.2. Isolated columns
- 2.3. Frame columns
- 2.4. Slender bridge piers

#### 3. Behaviour of structures in seismic areas

- 3.1. Seismic Design: Introduction
- 3.2. Structural seismic behaviour
- 3.3. Systems of One Degree of Freedom
- 3.4. Ductility
- 3.5. Shear design of Plastic Hinges Areas
- 3.6. Seismic design of bridges

#### 4. SLS behaviour

- 4.1. Rheological effects-Linear sectional and structural analysis
- 4.2. Imposed strains: nonlinear analysis
- 4.3. Integral structures

- 5. Behaviour of structures subjected to fire
  - 5.1. Introduction to fire curves. Fire design codes
  - 5.2. Material behaviour. Concrete and steel
  - 5.3. Sectional behaviour
  - 5.4. Behaviour of columns and structures
- 6. Fibre reinforced concrete
  - 6.1. Types of fibres and their application
  - 6.2. Steel fibres: SLS and ULS
  - 6.3. Textile fibres
- 7. Strut-and-tie method applied to structural elements
  - 7.1. Introduction, Pile Caps and Footings
  - 7.2. Concentrated loads, Brackets and Nodes
  - 7.3. Bridge Diaphragms, Deviators
- 8. Specific topics on prestressing
  - 8.1. Introduction to prestressing
  - 8.2. External prestress
  - 8.3. Prestress? layouts in buildings and bridges
  - 8.4. Prestress in curved structures
  - 8.5. Stays and cables

## 6. Schedule

### 6.1. Subject schedule\*

Week	Classroom activities	Laboratory activities	Distant / On-line	Assessment activities
1	<b>Theoretical class</b> Duration: 03:00 Lecture			
2	<b>Theoretical class</b> Duration: 03:00 Lecture			
3	<b>Theoretical class</b> Duration: 03:00 Lecture			
4	<b>Theoretical class</b> Duration: 03:00 Lecture			
5	<b>Theoretical class</b> Duration: 03:00 Lecture			
6	<b>Theoretical class</b> Duration: 03:00 Lecture			
7	<b>Theoretical class</b> Duration: 03:00 Lecture			<b>See evaluation criteria</b> Written test Continuous assessment Presential Duration: 03:00
8	<b>Theoretical class</b> Duration: 03:00 Lecture			
9	<b>Theoretical class</b> Duration: 03:00 Lecture			
10	<b>Theoretical class</b> Duration: 03:00 Lecture			
11	<b>Theoretical class</b> Duration: 03:00 Lecture			
12	<b>Theoretical class</b> Duration: 03:00 Lecture			
13	<b>Theoretical class</b> Duration: 03:00 Lecture			

14	<b>Theoretical class</b> Duration: 03:00 Lecture			
15	<b>Theoretical class</b> Duration: 03:00 Lecture			<b>See evaluation criteria</b> Written test Continuous assessment Presential Duration: 03:00
16	<b>Theoretical class</b> Duration: 03:00 Lecture			
17				<b>See evaluation criteria</b> Written test Final examination Presential Duration: 03:00

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.

\* The schedule is based on an a priori planning of the subject; it might be modified during the academic year, especially considering the COVID19 evolution.



## 7. Activities and assessment criteria

### 7.1. Assessment activities

#### 7.1.1. Assessment

Week	Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
7	See evaluation criteria	Written test	Face-to-face	03:00	50%	5 / 10	CB10 CT3 CE12
15	See evaluation criteria	Written test	Face-to-face	03:00	50%	5 / 10	CB10 CT3 CE12

#### 7.1.2. Global examination

Week	Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
17	See evaluation criteria	Written test	Face-to-face	03:00	100%	5 / 10	CB10 CT3 CE12

#### 7.1.3. Referred (re-sit) examination

No se ha definido la evaluación extraordinaria.

## 7.2. Assessment criteria

Evaluation through "continuous assessment"

PE1. Quizzes

PE2. First exam 50%

PE3. Second exam 50%

Description: Consists of two exams (PE2 and PE3), each one will have theoretical questions and practical exercises. In addition there will be four short in-class quizzes (PE1.1 to PE1.4) that will be given after the theoretical classes in non-previously announced dates.

Evaluation criteria: Two short quizzes (PE1.1 and PE1.2) will take place before the First exam (PE2) and the other two quizzes (PE1.3 and PE1.4) will take place before the Second exam (PE3). The short quizzes will be scored from 0 to 10 points. The arithmetic mean of PE1.1 and PE1.2 will be divided by 10 and will be used to increase the score of the First exam (PE2) only if the score of PE2 is greater than 4. The arithmetic mean of PE1.3 and PE1.4 will be divided by 10 and will be used to increase the score of the Second exam (PE3) only if the score of PE3 is greater than 4.

Place and period: To be determined by the Head of Studies

Result of the evaluation through "continuous assessment"

The final score will be: The arithmetic mean of the scores in PE2 and PE3.

The subject will be passed if the final score of both PE2 and PE3 is equal or greater than 5.

Those students with a score less than 5 in any of the two exams (PE2 and PE3) will not pass the subject and will have another opportunity in the second period examination (extraordinary), which will have the same format as the evaluation through ?final exam only?.

Evaluation through "final exam only"

Description: Consists of a single exam, which will last from 3 to 4 hours. This exam will be formed by several

theoretical and practical exercises related to any part of the contents of the subject.

Evaluation criteria: Each one of the exercises will be graded from 0 to 10 points. The final score will be the arithmetic mean of the scores obtained on each exercise.

Place and period: To be determined by the Head of Studies.

Result of the evaluation through "final exam only"

The final score will be the one obtained in the final exam.

The subject will be passed if the final score is equal or greater than 5.

Those students with a score less than 5 will not pass the subject.

## 8. Teaching resources

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### 8.1. Teaching resources for the subject

Name	Type	Notes
www.he-upm.com	Web resource	
Moodle UPM	Web resource	