



POLITÉCNICA

INTERNATIONAL
CAMPUS OF
EXCELLENCE

COORDINATION PROCESS OF
LEARNING ACTIVITIES
PR/CL/001



E.T.S. de Ing. de Caminos
Canales y P.

ANX-PR/CL/001-01

LEARNING GUIDE

SUBJECT

43000437 - Design, Analysis And Construction Of Bridges

DEGREE PROGRAMME

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

ACADEMIC YEAR & SEMESTER

2025/26 - Semester 2

Index

Learning guide

1. Description.....	1
2. Faculty.....	1
3. Prior knowledge recommended to take the subject.....	2
4. Skills and learning outcomes	2
5. Brief description of the subject and syllabus.....	3
6. Schedule.....	6
7. Activities and assessment criteria.....	7
8. Teaching resources.....	8
9. Other information.....	10

1. Description

1.1. Subject details

Name of the subject	43000437 - Design, Analysis And Construction Of Bridges
No of credits	4.5 ECTS
Type	Optional/elective
Academic year of the programme	First year
Semester of tuition	Semester 2
Tuition period	February-June
Tuition languages	English
Degree programme	04AM - Master Universitario Ingeniería de Estructuras, Cimentaciones y Materiales
Centre	04 - E.T.S. De Ing. De Caminos Canales Y P.
Academic year	2025-26

2. Faculty

2.1. Faculty members with subject teaching role

Name and surname	Office/Room	Email	Tutoring hours *
Jose Manuel Simon-Talero Muñoz	Torre 9º	jm.simon-talero@upm.es	M - 14:00 - 16:00 W - 14:00 - 16:00
Antonio Aureo Martinez Cutillas (Subject coordinator)	Torre 9º	a.martinez.cutillas@upm.es	Sin horario.
Alfredo Camara Casado	9ª Torre	alfredo.camara@upm.es	W - 16:00 - 19:00

* 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

3.1. Recommended (passed) subjects

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

3.2. Other recommended learning outcomes

- Dimensionamiento de estructuras de hormigón armado y pretensado

4. Skills and learning outcomes *

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.

CB6 - Poseer y comprender conocimientos que aporten una base u oportunidad de ser originales en el desarrollo y/o aplicación de ideas, a menudo en un contexto de investigación

CB9 - Que los estudiantes sepan comunicar sus conclusiones y los conocimientos y razones últimas que las sustentan a públicos especializados y no especializados de un modo claro y sin ambigüedades

CE11 - 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 puentes.

CG1 - Polivalencia para extender a ámbitos afines las competencias generales adquiridas en el ámbito temático del título.

CG4 - Capacidad de comunicación académica de contenido técnico y científico, oral y escrita en lengua inglesa.

CG5 - Capacidad de utilización de los servicios de comunicación y de obtención de información para su transformación en conocimiento aplicable al ejercicio de las competencias específicas.

4.2. Learning outcomes

RA31 - Asume los principios de incertidumbre y riesgo en la aplicación de los métodos y modelos de estructuras para el estudio de los puentes.

RA3 - Interioriza los principios de deontología profesional para actividades de I+D+i

RA30 - Plantea el método de construcción de un puente

RA4 - Utiliza con eficacia recursos de información y comunicación

RA8 - Utiliza con eficacia recursos de modelización predictiva en una o más de las materias del módulo

RA2 - Presenta comunicaciones orales, escritas y gráficas, estructurada y argumentadamente, en lengua española e inglesa

* 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

5.1. Brief description of the subject

The teacher will explain the concepts necessary to understand the concepts of the course in order for the student to achieve the expected indicators. The teacher will use appropriate practical examples and logical reasoning to develop the scientific and technical abilities of the student. The participation of students will be encouraged by means of discussions on the topics taught.

Practice lessons will be aimed at the resolution of exercises and case-studies. Practice lessons are intended as a correlation between the content of theory lessons and engineering practice, in order for the student to achieve the ability to apply the acquired knowledge in the future career. The teacher will first solve some exercises and case-studies to show the students how to work on their own later.

5.2. Syllabus

1. Introduction to non conventional, medium span or large span bridges
 - 1.1. Determinants that led to plan a non conventional bridge. Bridge typology. Examples.
2. The box girder bridge
 - 2.1. Transverse and longitudinal morphology. Resistant behaviour: longitudinal bending, transverse bending, torsion, non uniform torsion, distortion
 - 2.2. application of numerical methods, bridge modelling.
 - 2.3. Construction: movable scaffolding system, launching girder, cantilever segmental construction, precast segments, incremental launching.
3. The skew bridge
 - 3.1. Morphology, supporting conditions, resistant behaviour, precast beams deck, slab deck, closed box deck. Modelling, prestressing. Applications.
4. The curved bridge
 - 4.1. Morphology, supporting conditions, resistant behaviour, precast beams deck, slab deck, closed box deck. Modelling, prestressing. Applications.
5. The portal frame bridge
 - 5.1. Morphology, supporting conditions, resistant behaviour depending on the ground and supporting conditions, prestressing design, construction, applications.
6. The railroad bridge
 - 6.1. Morphology. Special features of the hi-speed railroad bridges. Specific actions on railroad bridges.
 - 6.2. Spanish and European regulation. Serviceability conditions. Location of expansion joints in the bridge and on the road. Introduction to dynamic effects.
7. Arch bridges
 - 7.1. Morphology. Linkages. Resistant behaviour: deck bridge, through bridge, spandrel arch bridge, network arch bridge. Arch construction. Applications.
8. Cable-stayed bridges.
 - 8.1. Longitudinal morphology. Transverse morphology. Towers. Cable properties. Cable-stayed bridge behaviour against vertical and horizontal actions.
 - 8.2. Calculation of cable-stayed bridges. Definition of reference state. Modelling. Construction process: cantilever method, over provisional supports. Applications.

9. Extradosed bridges.

9.1. Longitudinal morphology. Transverse morphology. Towers. Cable properties. Extradosed bridge behaviour against vertical and horizontal actions.

9.2. Calculation of extradosed bridges. Definition of reference state. Construction process

10. Extraordinary actions.

10.1. Scouring: description, research, protection design. Ship collision: description, actions during the collision, calculation, protection against the ship collision.

11. Inspection and maintenance.

11.1. Bridge management. Periodic inspection policy. Maintenance programs. Bridge rehabilitation.

12. Integral and semi integral bridges.

12.1. Justification, morphology, design and analysis, applications.

6. Schedule

6.1. Subject schedule*

Week	Type 1 activities	Type 2 activities	Distant / On-line	Assessment activities
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16	Preparación Examen Final Duration: 00:00 Additional activities			Examen Final Ordinario Written test Progressive assessment Presential Duration: 00:00
17				Examen Final Extraordinario Written test Global 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.

7. Activities and assessment criteria

7.1. Assessment activities

7.1.1. Assessment

Week	Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
16	Examen Final Ordinario	Written test	Face-to-face	00:00	100%	5 / 10	CG1 CG4 CG5 CB6 CB9 CB10 CE11

7.1.2. Global examination

Week	Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
17	Examen Final Extraordinario	Written test	Face-to-face	03:00	100%	5 / 10	

7.1.3. Referred (re-sit) examination

Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
Extraordinary exam: it has the same structure as the final exam. It consists of two parts: one theoretical and another practical.	Written test	Face-to-face	02:00	100%	5 / 10	CG1 CG4 CG5 CB6 CB9 CB10 CE11

7.2. Assessment criteria

Evaluation through final exam only

Description: Consists of the same final exam as the one that will do the students who choose the continuous assessment evaluation.

Evaluation criteria: Each of the exercises will be ranked from 0 to 10 points. The final score will be the arithmetic mean of the scores obtained in each exercise provided that the marks obtained in the first and the second parts are not lower than 3.5.

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

8. Teaching resources

8.1. Teaching resources for the subject

Name	Type	Notes
Hewson N.R. (2003), Prestressed Concrete Bridges, Thomas Telford	Bibliography	Basic
Manterola J. (2006), Puentes: Apuntes para su Diseño, Cálculo y Construcción, Colegio de Ingenieros de Caminos, Canales y Puertos	Bibliography	Basic
Menn C.(1986), Prestressed Concrete Bridges, BirkHäuser Verlag	Bibliography	Basic
Walther R., Houriet B., Isler W., Moia P. & Klein J.F. (1999), Cable Stayed Bridges, Thomas Telford	Bibliography	Basic

Benaim R. (2008), The Design of Prestressed Concrete Bridges, Taylos & Francis	Bibliography	complementary
Calgaro J.A. (1988), Projet et Construction des Ponts: Analyse Structurale des Tabliers de Ponts, Presses de l'École Nationale des Ponts et Chaussées	Bibliography	complementary
Leonhardt F. (1982), Bridges, Deustche Verlags-Anstalt	Bibliography	complementary
Liebenberg A.C. (1992), Concrete Bridges: Design and Construction, Longman Scientific and Technical	Bibliography	complementary
Monleón S. (1997), Ingeniería de Puentes: Análisis Estructural, Universidad Politécnica de Valencia	Bibliography	complementary
Svensson H. (2012), Cable Stayed Bridges: 40 Years of Experience Worldwide, Wiley	Bibliography	complementary
Área virtual de la ETSICCP. Área virtual (MOODLE).	Web resource	
Biblioteca del departamento de Mecánica de Medios Continuos y Teoría de Estructuras.	Equipment	

9. Other information

9.1. Other information about the subject

Theory lessons:

The teacher will explain the concepts necessary to understand the concepts of the course in order for the student to achieve the expected indicators. The teacher will use appropriate practical examples and logical reasoning to develop the scientific and technical abilities of the student. The participation of students will be encouraged by means of discussions on the topics taught.

Practice lessons:

Practice lessons will be aimed at the resolution of exercises and case-studies. Practice lessons are intended as a correlation between the content of theory lessons and engineering practice, in order for the student to achieve the ability to apply the acquired knowledge in the future career. The teacher will first solve some exercises and case-studies to show the students how to work on their own later.

Laboratory classes:

No laboratory classes will be conducted on this subject

Independent work:

The student shall study the contents explained in theory lessons and shall strive to solve the exercises and case-studies.

Group work:

There are not any specific group works.

Office hours

Office hours are intended as a complement for the students to ask questions on the content of the course. Details of office hours are detailed at the beginning of this guide for each teacher.