

## COURSE SYLLABUS

**Academic Year: 2024/2025**

Identification and characteristics of the course			
Code	503141	ECTS Credits	6
Course title (English)	RAILWAYS		
Course title (Spanish)	FERROCARRILES		
Degree programs	Civil Engineering Degree – Transport and Urban Services		
Faculty/School	School of Technology (Caceres).		
Semester	7	Course type (compulsory/optional)	Compulsory
Module	Module 3 (Specific Technological Training in Transport and Urban Services) Module 3 (Specific Technological Training in Civil Constructions)		
Subject matter	Transportation Engineering		
Lecturer/s			
Name	Room	E-mail	Web page
Juan Francisco Coloma Miró	OP-17	jfcoloma@unex.es	<a href="http://www.unex.es/conoce-la-unex/centros/epcc">http://www.unex.es/conoce-la-unex/centros/epcc</a>
Subject Area	Transport Engineering and Infrastructure		
Department	Construction		
Coordinator (Only if there is more than one lecturer)			

Competencies*
<p><b>GENERAL COMPETENCES</b></p> <p>CG1 - Scientific-technical training for the exercise of the profession of Civil Works Technical Engineer and knowledge of the functions of consulting, analysis, design, calculation, project, construction, maintenance, conservation and exploitation.</p> <p>CG2 - Understanding of the multiple technical and legal conditions that arise in the construction of a civil work, and the ability to use proven methods and accredited technologies, in order to achieve greater efficiency in construction while respecting the environment and the protection of the safety and health of workers and users of civil works.</p> <p>CG3 - Knowledge, understanding and ability to apply the necessary legislation during the exercise of the profession of Technical Engineer of Civil Works.</p> <p>CG4 - Ability to project, inspect and direct works in its field.</p> <p>CG7 - Capacity for the maintenance, conservation and exploitation of infrastructures, in its scope.</p>
<p><b>SPECIFIC</b></p> <p>CECC5 - Capacity for the construction and maintenance of railway lines with knowledge to apply the specific technical regulations and differentiating the characteristics of rolling stock.</p> <p>CECC6 - Ability to apply construction procedures, construction machinery and construction planning techniques.</p>

**BASICS**

CB1: That students have demonstrated to possess and understand knowledge in an area of study that starts from the base of general secondary education, and it is usually found at a level that, although supported by advanced textbooks, also includes some aspects which involve knowledge coming from the cutting edge of their field of study.

CB2: That students know how to apply their knowledge to their work or vocation in a professional way and possess the competencies that are usually demonstrated through the elaboration and defence of arguments and the resolution of problems within their area of study.

CB3: That students have the ability to gather and interpret relevant data (usually within their study area) to make judgments that include a reflection on relevant issues of a social, scientific or ethical nature.

CB4: That students can transmit information, ideas, problems and solutions to both a specialized and non-specialized audience.

CB5: That students have developed those learning skills necessary to undertake further studies with a high degree of autonomy.

**Contents**

**Course outline\***

Basic knowledge for the project of a railway track and its facilities will be taught, as well as the existing equipment for the construction and maintenance of the railway tracks. In addition, traction-adherence, stress, dimensioning railway section and crash problems will be carried out.

**Course contents**

Title of chapter 1: The railroad. Characteristics.

Contents of chapter 1: Historical development of the FFCC. Legislation applicable to the FFCC. Classification of lines. Measurements of rail traffic. Characteristics of rail transport. Prospects and opportunities of the FFCC.

Description of the practical activities of chapter 1:

PRACTICAL 1 and 2. Railway networks.

PRACTICE 3. Train speed/acceleration problem.

Title of chapter 2: Traction in railroads.

Contents of chapter 2: Resistance in straight and horizontal. Resistance due to curves. Resistance due to ramps. Fictitious ramp or corrected profile. Total resistance at constant speed. Inertia resistance. Resistance at start-up. General approach to the traction problem. Towing forces. Virtual lengths.

Description of the practical activities of chapter 2

PRACTICE 4, 5 and 6. Traction-adhesion problems.

Title of the chapter 3: Electric traction.

Contents of chapter 3: Introduction. Power supply. Overhead contact line. Third rail. Catenary. Contact wire. Actions on the catenary. Catenary mechanical voltage compensation. Isolation. Supporting. Feeding. Pantograph. Study of the catenary - pantograph system. Third rail. Introduction. Characteristics. Types. Isolations. Electrification of the Spanish high speed train.

Title of the chapter 4: Diesel traction.

Contents of chapter 4: Introduction. Diesel engine. Brief description. Properties of diesel engines. Turbo engines. Brief description. Properties of turbomotors. Transmission. Mechanical transmission. Electric transmission. Hydraulic transmission. Advantages and disadvantages of diesel traction. Performance. Comparison with steam and electric traction. Heating. Soundproofing. Types of diesel locomotives. History and development of diesel traction.

Title of the chapter 5: Braking in trains.

Contents of chapter 5: Introduction. Traction. Adhesion and rolling. Braking. Kinematic analysis and dynamic analysis. Basic concepts of braking. Braking to the load of the FFCC. Emergency and service brakes.

Description of the practical activities of chapter 5:

PRACTICE 7. Braking problem.

PRACTICE 8 and 9. Crash problem.

Description of chapter 6: Elements of the conventional and slab track.

Contents of chapter 6: The raceway. Track gauge. The ballastless track.

Name of chapter 7: Track dimensioning. Vertical forces.

Contents of chapter 7: Forces acting on the track. Fundamental parameters. Track-vehicle interaction. Vertical forces. Calculation methods and essential factors for their interpretation. Transmission of vertical forces rail - sleeper - ballast. Transmission of vertical forces ballast - platform.

Description of the practical activities of chapter 7:

PRACTICE Nº10, 11 AND 12. Vertical forces.

Name of the chapter 8: Track dimensioning. Horizontal forces.

Contents of chapter 8: Transverse forces. Horizontal forces to be considered. Horizontal forces.

Derailment. Nadal's formula 2. Longitudinal forces. Temperature.

Description of the practical activities of chapter 8:

PRACTICE 13. Horizontal forces.

Title of chapter 9: Infrastructure. The platform, works and tunnels.

Contents of chapter 9: Infrastructure. The platform. Floors for platforms. Classification of platforms. Earthworks. Slopes. Masonry works. Walls. Works of small span. Large masonry works. Overpasses and underpasses. Siphons. Ditches and drainage works. Tunnels. Aerodynamic effects. Compression effects in tunnels. Water effects in railway tunnels.

Title of chapter 10: The superstructure. The subbase and ballast.

Contents of chapter 10: Introduction. The ballast. Functions. Characteristics. Thickness and width. The subballast.

Title of the chapter 11: The superstructure. Sleepers

Contents of chapter 11: Origin and function of sleepers. Classification of sleepers. Wooden sleepers. Metal sleepers. Concrete sleepers. Synthetic sleeper. Multipurpose sleepers.

Title of the chapter 12: The superstructure. The rail

Contents of chapter 12: Definition. Main functions. To support the loads. To guide the vehicle. To constitute a comfortable and safe roadway. Characteristics

Name of the chapter 13: The superstructure. Small track equipment

Contents of chapter 13: Introduction. Rail fastenings. Functions. Rigid fastenings. Elastic fastenings. Wedge and bearing fastening. Fastening for track on concrete slab. Joints. Generalities. Functions. Types of flanges. Working conditions. Types. Problems

Title of the chapter 14: Geometry of the track.

Contents of chapter 14: Superelevation. Layout in plan. Circular and transition curves. Layout in elevation. Between tracks. Overspans. Minimum radii.

Description of the practical activities of chapter 14:

PRACTICE 14, 15. Railroad track layout.

Name of the chapter 15: Switches and crossings.

Contents of chapter 15: Functional concept. Fundamental organs. Single crossing. Double crossing. Switches. Offsets. Constructive arrangements and calculation of the turnout. Turnout actuation. Sleepers. Other devices. Representation of switches and crossings. Track spikes.

Description of the practical activities of the chapter 15:

PRACTICE nº16. Track devices

Title of chapter 16: Railway terminals and their functions. Lines and terminals

Contents of chapter 16: Lines. Basic characteristics of lines from the point of view of their operation. Commercial characteristics of lines from the point of view of their operation.

Terminals and their operation. Freight stations. Passenger stations. Freight sorting and classification stations. Technical sidings for passengers and freight. Intermodal transport. Logistic platforms

Title of the chapter 17: Signaling, driving safety: interlockings and blocking and driving assistance systems: ASFA and ERTMS.

Contents of chapter 17: Technical specifications for interoperability. Freight trains. Signaling. Type of vehicles in the Spanish network. Level crossings. Traffic safety. Interlockings (stations) and blocking (on lines). CTC (centralized traffic control). GRP, the Route and Priority Manager. Driving assistance systems. ASFA AND ERTMS.

Title of chapter 18: Track construction, renewal and maintenance.

Contents of chapter 18: Justification and importance. Initial problems. Execution of infrastructure works (renewal). Execution of superstructure works. Methodical maintenance of the track. Mechanization of track maintenance.

Educational activities *								
Student workload (hours per lesson)		Lectures	Practical sessions				Monitoring activity	Homework
Lesson	Total	L	HI	LAB	COM	SEM	SGT	PS
1	11,00	4,00				2,00		5,00
2	17,00	2,00			3,00			12,00
3	6,00	2,00						4,00
4	6,00	2,00						4,00
5	16,00	3,00			3,00			10,00
6	6,00	2,00						4,00
7	21,00	3,00			3,00			15,00
8	19,00	3,00			1,00			15,00
9	4,00	2,00						2,00
10	4,00	2,00						2,00
11	4,00	2,00						2,00
12	4,00	2,00						2,00
13	4,00	2,00						2,00
14	7,00	3,00				2,00		2,00
15	5,00	2,00				1,00		2,00
16	4,00	2,00						2,00
17	4,00	2,00						2,00
18	5,00	2,00						3,00
<b>Assessment **</b>	3,00	3,00						
<b>TOTAL ECTS</b>	<b>150</b>	<b>45</b>			<b>10</b>	<b>5</b>		<b>90</b>

L: Lectures (85 students)  
 HI: Hospital internships (7 students)  
 LAB: Lab sessions or field practice (15 students)  
 COM: Computer room or language laboratory practice (20 students)  
 SEM: Problem-solving classes, seminars or case studies (40 students)  
 SGT: Scheduled group tutorials (educational monitoring, ECTS type tutorials)  
 PS: Personal study, individual or group work and reading of bibliography

Teaching Methodology*
• Lectures and resolution of exercises with active participation of the students.

\*\* Indicate the total number of hours of evaluation of this subject.

- Personalized and / or small group work on the knowledge acquired in the theoretical and practical classes.
- Search for bibliographic information.
- Preparation of technical documents.
- Use of information and communication techniques (ICT).

### Learning outcomes \*

The subject will equip the students in civil engineering with the basic knowledge for the project of a railway track and its facilities. The student will know the existing equipment for the construction and conservation of the railways. In addition, traction-adherence practices, efforts, railway dimension, and crash problems will be carried out.

### Assessment methods \*

During the first three weeks of the course, the student must choose the continuous or global assessment system.

The continuous evaluation system will take into account the attendance and delivery of practices that will be requested throughout the course so that the student takes a correct follow-up and learning of the subject. The score for this part will be 20% and the exam score 80%.

For the students of the global assessment, the exam will count 100% of their final grade, not taking into account the attendance or the delivery of the practices.

#### Ordinary evaluation.

The resolution of three questions is evaluated in a written exam. For those of continuous evaluation, the exam will count 80% of the grade, being 20% attendance and delivery of practices. For global assessment students, the exam of this call will count 100% of their final grade.

#### Extraordinary evaluation.

It will be assessed with the same criteria adopted in ordinary calls. The resolution of three questions is evaluated in a written exam. For those of continuous evaluation, the exam will count 80% of the grade, being 20% attendance and delivery of practices. For global assessment students, the exam of this call will count 100% of their final grade

### Bibliography (basic and complementary)

#### Basic:

Teacher's own notes.

NAP 1-2-1.0. Metodología para el diseño del trazado ferroviario. 1ª Edición. 2021.

#### Complementary:

ADIF normative

Tratado de ferrocarriles I. La vía. Fdo. Oliveros. 1975.

Tratado de ferrocarriles II. Ing. civil e instalaciones. Fdo. Oliveros. 1980.

Temas ferroviarios 1 a 6 - M. A. Hacar y Otros — 1982.

### Other resources and complementary materials

The virtual campus will be used to make available to the student the information related to the subject: topics, related bibliography, didactic resources, updated normative, links to web pages of interest related to the current status of the subject, practices, exams from previous years, etc.