Degree competences to which the subject contributes

Specific:

3091. Ability to construct, conserve, dimension and design roads and the items comprising basic road provision

3092. Ability to construct and conserve railway lines with knowledge of the application of the specific technical regulations, differentiating the characteristics of the rolling stock

General:

3105. Students will learn to identify, formulate and solve a range of engineering problems. They will be expected to show initiative in interpreting and solving specific civil engineering problems and to demonstrate creativity and decision-making skills. Finally, students will develop creative and systematic strategies for analysing and solving problems.

3106. Students will learn to assess the complexity of the problems examined in the different subject areas, identify the key elements of the problem statement, and select the appropriate strategy for solving it. Once they have chosen a strategy, they will apply it and, if the desired solution is not reached, determine whether modifications are required. Students will use a range of methods and tools to determine whether their solution is correct or, at the very least, appropriate to the problem in question. More generally, students will be encouraged to consider the importance of creativity in science and technology.

3107. Students will learn to identify, model and analyse problems from open situations, consider alternative strategies for solving them, select the most appropriate solution on the basis of reasoned criteria, and consider a range of methods for validating their results. More generally, students will learn to work confidently with complex systems and to identify the interactions between their components.

3111. Students will learn to plan, design, manage and maintain systems suitable for use in civil engineering. They will develop a systematic approach to the complete life-cycle of a civil engineering infrastructure, system or service, which includes drafting and finalising project plans, identifying the basic materials and technologies required, making decisions, managing the different project activities, performing measurements, calculations and assessments, ensuring compliance with specifications, regulations and compulsory standards, evaluating the social and environmental impact of the processes and techniques used, and conducting economic analyses of human and material resources.

3112. Students will develop an understanding of the different functions of engineering, the processes involved in the life-cycle of a construction project, process or service, and the importance of systematising the design process. They will learn to identify and interpret the stages in preparing a product design specification (PDS), draft and optimise specifications and planning documents, and apply a systematic design process to the implementation and operation phases. Students will learn to write progress reports for a design process, use a range of project management tools and prepare final reports, and will be expected to show an awareness of the basic economic concepts associated with the product, process or service in question.

3113. Students will learn to identify user requirements, to draft definitions and specifications of the product, process or service in question, including a product design specification (PDS) document, and to follow industry-standard design management models. Students will be expected to show advanced knowledge of the steps involved in the
Students will gain an understanding of transport infrastructure.

Transport and urban services pathway

Specialised knowledge of basic transport infrastructure concepts covered in an earlier subject on transport and regional organisation.

**Learning objectives of the subject**

- Students will gain an understanding of transport infrastructure.
- Transport and urban services pathway
- Specialised knowledge of basic transport infrastructure concepts covered in an earlier subject on transport and regional organisation

**Study load**

<table>
<thead>
<tr>
<th>Total learning time: 150h</th>
<th>Hours large group: 37h</th>
<th>24.67%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hours medium group: 14h</td>
<td>9.33%</td>
<td></td>
</tr>
<tr>
<td>Hours small group: 9h</td>
<td>6.00%</td>
<td></td>
</tr>
<tr>
<td>Guided activities: 6h</td>
<td>4.00%</td>
<td></td>
</tr>
<tr>
<td>Self study: 84h</td>
<td>56.00%</td>
<td></td>
</tr>
</tbody>
</table>

The course consists of 4 hours per week of classroom activity.

The 2.5 hours are devoted to theoretical lectures, in which the teacher presents the basic concepts and topics of the subject, and the 0.9 hours are devoted to show examples and solves exercises (average).

The rest of weekly hours devoted to tests.

Support material in the form of a detailed teaching plan is provided using the virtual campus ATENEA: content, program of assessment activities and conducted learning, literature.
### 0. Presentation

**Learning time:** 2h 24m  
- Theory classes: 1h  
- Self study: 1h 24m

**Description:**  
Objectives, faculty, calendar, evaluation system, bibliography.

### 1. ROADS. Earthworks construction

**Learning time:** 9h 36m  
- Theory classes: 2h  
- Practical classes: 2h  
- Self study: 5h 36m

**Description:**  
Previous operations to earthmoving. Landfills and rockfills. Soil compaction machinery. Quality control.  
Completion and refinement. Protection against erosion.  
Specifications implementation.  
Soil stabilized design, specifications application.

### 2. Aggregates

**Learning time:** 2h 24m  
- Theory classes: 1h  
- Self study: 1h 24m

**Description:**  
Production and quality control. Specifications.

### 3. Hydrocarbon binders

**Learning time:** 4h 48m  
- Theory classes: 2h  
- Self study: 2h 48m

**Description:**  
Production. Specifications and applications.
### 4. Granular layers

**Learning time:** 2h 24m  
Theory classes: 1h  
Self study: 1h 24m

**Description:**  
Preparation of granular bases, laying and compaction, quality control. Specifications.

### 5. Cement treated gravel

**Learning time:** 4h 48m  
Theory classes: 1h  
Practical classes: 1h  
Self study: 2h 48m

**Description:**  
Manufacture, laying and compaction, quality control work. Specifications. Problems of cement treated bases.

### 6. Bituminous surface treatments and slurry seals

**Learning time:** 4h 48m  
Theory classes: 1h  
Practical classes: 1h  
Self study: 2h 48m

**Description:**  

### 7. Bituminous mixtures

**Learning time:** 12h  
Theory classes: 2h  
Practical classes: 3h  
Self study: 7h

**Description:**  
<table>
<thead>
<tr>
<th>8. Cement concrete pavements</th>
<th>Learning time: 7h 11m</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Theory classes: 1h</td>
</tr>
<tr>
<td></td>
<td>Practical classes: 2h</td>
</tr>
<tr>
<td></td>
<td>Self study : 4h 11m</td>
</tr>
</tbody>
</table>

**Description:**
- General characteristics. Manufacture, laying, compaction and quality control. Specifications.
- Cement concrete pavement problems.

<table>
<thead>
<tr>
<th>9. RAILWAYS. Organization of passengers transport</th>
<th>Learning time: 12h</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Theory classes: 5h</td>
</tr>
<tr>
<td></td>
<td>Self study : 7h</td>
</tr>
</tbody>
</table>

**Description:**
- Local and regional services
- Conventional and high-speed interurban services
- Stations for passenger transport

<table>
<thead>
<tr>
<th>10. Organization of freight transport</th>
<th>Learning time: 12h</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Theory classes: 5h</td>
</tr>
<tr>
<td></td>
<td>Self study : 7h</td>
</tr>
</tbody>
</table>

**Description:**
- Organization of freight transport
- Freight terminals

<table>
<thead>
<tr>
<th>11. The movement of a train. Start and circulation at constant speed. Braking</th>
<th>Learning time: 9h 36m</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Theory classes: 3h</td>
</tr>
<tr>
<td></td>
<td>Practical classes: 1h</td>
</tr>
<tr>
<td></td>
<td>Self study : 5h 36m</td>
</tr>
</tbody>
</table>

**Description:**
- Resistance to the advancement of a vehicle
- Load towable by a train at the start and at constant speed
- Resistance to the advancement of high-speed trains.
- Main aspects of the braking of a train
### 12. Geometrical planning criteria of a line

**Learning time:** 4h 48m  
Theory classes: 1h  
Practical classes: 1h  
Self study: 2h 48m

**Description:**  
Geometric parameters for the design of new lines  
Influence of the operating system

### 13. Signalling and rail protection systems

**Learning time:** 4h 48m  
Theory classes: 2h  
Self study: 2h 48m

**Description:**  
Principles of signalling and protection systems  
Description of protection systems in conventional lines  
First protection systems in high-speed lines

### 14. ATO, driverless and unattended

**Learning time:** 2h 24m  
Theory classes: 1h  
Self study: 1h 24m

**Description:**  
ATP Speed Control Systems  
Degree of driving automation: ATO, Driverless, Unattended. CBTC

### 15. ERTMS

**Learning time:** 2h 24m  
Theory classes: 1h  
Self study: 1h 24m

**Description:**  
Interoperability ERTMS

### 16. Systems of operation and capacity of lines

**Learning time:** 4h 48m  
Theory classes: 2h  
Self study: 2h 48m

**Description:**  
Operating systems  
Capacity of the lines
<table>
<thead>
<tr>
<th>Section</th>
<th>Learning time</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>17. Programming of the rail service</strong></td>
<td>4h 48m</td>
</tr>
<tr>
<td>Description:</td>
<td></td>
</tr>
<tr>
<td>Graphs of departure</td>
<td></td>
</tr>
<tr>
<td>Itinerary books. Planning of staff shifts and fleet rostering</td>
<td></td>
</tr>
<tr>
<td><strong>18. Construction and renovation of a railway line</strong></td>
<td>4h 48m</td>
</tr>
<tr>
<td>Description:</td>
<td></td>
</tr>
<tr>
<td>The realization of the infrastructure</td>
<td></td>
</tr>
<tr>
<td>Superstructure assembly</td>
<td></td>
</tr>
<tr>
<td><strong>19. Environment, noise and vibration</strong></td>
<td>2h 24m</td>
</tr>
<tr>
<td>Description:</td>
<td></td>
</tr>
<tr>
<td>Environmental impact. Noise and vibration. Corrective measures</td>
<td></td>
</tr>
<tr>
<td><strong>20. The electrification of a line. Design criteria</strong></td>
<td>4h 48m</td>
</tr>
<tr>
<td>Description:</td>
<td></td>
</tr>
<tr>
<td>Basic design parameters for the electrification of a line</td>
<td></td>
</tr>
<tr>
<td>Problems derived from the pantograph-catenary interaction</td>
<td></td>
</tr>
<tr>
<td><strong>21. Control</strong></td>
<td>24h</td>
</tr>
<tr>
<td>Laboratory classes:</td>
<td></td>
</tr>
<tr>
<td>10h</td>
<td></td>
</tr>
<tr>
<td>Self study: 14h</td>
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</tbody>
</table>
Qualification system

For assessment purpose, the course consists of three parts:

- Roads (C)
- Railways (FC)

During the semester of the course there will be two tests for each of the two parts that will be taught in parallel. There will also be an assessable activity (A) that will be evaluated for the (C) part, which will be weighted as 30% of the corresponding mark.

An average mark will be obtained from each part (C or FC). The mark of the each part will be obtained from the corresponding exams (and assessable activity in the case of C):

\[
\text{Mark (C)} = 0.70 \times \left( \frac{\text{mark C1} + \text{mark C2}}{2} \right) + 0.30 \times \text{mark A}
\]
\[
\text{Mark (FC)} = \frac{\text{mark ExFC1} + \text{mark ExFC2}}{2}
\]

The overall course mark (MARK) will be obtained as:

\[
\text{MARK} = \frac{\text{Mark (C)} + \text{Mark (FC)}}{2}
\]

In the case that the student does not attend one of these tests, with the aim of calculating the MARK, the mark of that part will be considered zero.

To pass the course, the student’s course mark must be \( \geq 5 \).

In addition there will be a retaking exam at the end of the semester, for those students with a mark below 5.0.

The MARK will be NP when the student does not attend the retaking exam.

Regulations for carrying out activities

Failure to perform a laboratory or continuous assessment activity in the scheduled period will result in a mark of zero in that activity.
Bibliography

Basic:


Complementary:


