



## Course guide

### 220221 - 220221 - Railway Systems

Last modified: 19/04/2023

**Unit in charge:** Terrassa School of Industrial, Aerospace and Audiovisual Engineering  
**Teaching unit:** 712 - EM - Department of Mechanical Engineering.

**Degree:** MASTER'S DEGREE IN INDUSTRIAL ENGINEERING (Syllabus 2013). (Optional subject).  
MASTER'S DEGREE IN AERONAUTICAL ENGINEERING (Syllabus 2014). (Optional subject).  
MASTER'S DEGREE IN SPACE AND AERONAUTICAL ENGINEERING (Syllabus 2016). (Optional subject).  
MASTER'S DEGREE IN RESEARCH IN MECHANICAL ENGINEERING (Syllabus 2021). (Optional subject).

**Academic year:** 2023    **ECTS Credits:** 3.0    **Languages:** English

#### LECTURER

**Coordinating lecturer:** Xavier Salueña Berna

**Others:** Jordi Orta Roca

#### TEACHING METHODOLOGY

The course is divided into parts:

Theory classes

Practical classes

Self-study for doing exercises and activities.

In the theory classes, teachers will introduce the theoretical basis of the concepts, methods and results and illustrate them with examples appropriate to facilitate their understanding.

In the practical classes (in the classroom), teachers guide students in applying theoretical concepts to solve problems, always using critical reasoning. We propose that students solve exercises in and outside the classroom, to promote contact and use the basic tools needed to solve problems.

Students, independently, need to work on the materials provided by teachers and the outcomes of the sessions of exercises/problems, in order to fix and assimilate the concepts.

The teachers provide the syllabus and monitoring of activities (by ATENEA).

#### LEARNING OBJECTIVES OF THE SUBJECT

The course provides basic knowledge of the railway as a means of transportation and focuses its scope in the field of industrial engineering. The various topics that have been chosen up as a starting point for everyone who wants to be or has been in railways specialize in this sector. However, the object of the course is more general, to use the railway as a clear example of the application of different specialties so that concur in draft and in its operation. And this also is aimed at anyone who wants to learn how to check and apply in a different case knowledge acquired during the race.

In line with this, the first goal is learning descriptive of knowledge of the facilities track, signals and electrification; vehicles; materials and components; railway operation. The second is a learning analytical formula to deduce and apply through the technical study of some selected cases, the third objective is economic learning to analyze economic aspects of railway activity and assess their viability. The course includes lectures, demonstration sessions and visits to offices and railway facilities.

#### STUDY LOAD

Type	Hours	Percentage
Hours large group	27,0	36.00
Self study	48,0	64.00

**Total learning time:** 75 h



## CONTENTS

### Module 1: Rail layout

**Description:**

Characterization of the track. Circular curves. Cant. Horizontal transitions. Clotoide. Gradients. Elevation changes. Vertical agreements.

**Related activities:**

1,3

**Full-or-part-time:** 9h

Theory classes: 2h

Self study : 7h

### Module 2: Geometry, kinematics and effort on the road

**Description:**

Gauge. Tolerances and wide. Rail line. Leveling warping. Curved arrows. Cant. Cant failure. Tilt. Speed rollover. Vertical efforts. Lateral efforts. Longitudinal forces. Deformation vertical Winkler hypothesis, Zimmermann and Timoshenko. Deformation horizontal and limits. Expansion of rail.

**Related activities:**

1,3

**Full-or-part-time:** 20h

Theory classes: 10h

Self study : 10h

### Module 3: Railway, switches and crossings

**Description:**

Functions of the road. Systems track. Track. Fixations. Sleepers. Ballast. Slab track. platform. Drain. Needle exchange rate. Geometry changes needle. Operation and interlocking needle changes. Wreck rail wedges. Minirail. Toper. Expansion devices. Brides binding. Welding of rails. Road maintenance.

**Related activities:**

1,2,3

**Full-or-part-time:** 4h

Theory classes: 2h

Self study : 2h

### Module 4: Electrification.

**Description:**

Pressures of work. Subcentrals. Feeders and disconnectors. Catenary systems. Geometric features. Support of the catenary. Expansions. Decentralization and cable-stayed. Dynamics of overhead. Seccion and insulators. Needles air. Analysis electricity. Warming of the catenary. Insulation and earthing. Return circuit. Capturing energy: the pantograph.

**Related activities:**

1,2,3

**Full-or-part-time:** 6h

Theory classes: 2h

Self study : 4h



### Module 5: Railway safety. Signs

**Description:**

Concepts. Railway signals. Facilities security. Track circuits. Blocking signals. Repeating signal cabin and driving aids: ASFA, ATP, ATO, ERTMS. Automatic driving.

**Related activities:**

1,2,3

**Full-or-part-time:** 6h

Theory classes: 2h

Self study : 4h

### Module 6: Traction and braking

**Description:**

Technology traction. Curves of constant power. Adhesive weight. Maximum tractive effort. Resistance movement. Ramps and curves. Determination of the maximum speed. Variation of speed. Braking. Braking devices. Acceleration of braking. Locking wheels. Braking distance.

**Related activities:**

1,3,4

**Full-or-part-time:** 6h

Theory classes: 2h

Self study : 4h

### Module 7: Wheel-rail contact.

**Description:**

Shaft mounted. Dimensions. Line rolling. Contact tensions. Roughness and wear. Vibrations

**Related activities:**

1,3,4

**Full-or-part-time:** 4h

Theory classes: 2h

Self study : 2h

### Module 8: Wreck action.

**Description:**

Wreck theory. Formula of Nadal. Discussion.

**Related activities:**

1,3,4

**Full-or-part-time:** 12h

Theory classes: 4h

Self study : 8h



### Module 9: Cross section. Gauge. Accessibility

**Description:**

Importance of the cross section. Force gauge, gauge static. Kinematic gauge. Low headroom. Height and distance to the platform. Accessibility principles.

**Related activities:**

1,3,4

**Full-or-part-time:** 4h

Theory classes: 2h

Self study : 2h

### Module 10: financial Management

**Description:**

Demand. Offer. Market. Spending and investment. Feasibility.

**Related activities:**

1,3,4

**Full-or-part-time:** 4h

Theory classes: 2h

Self study : 2h

## ACTIVITIES

### Activity 1: Assistance to Project sessions

**Description:**

Assistance to Project sessions.

**Specific objectives:**

Builds a Railroad Project.

**Material:**

Atenea notes platform.

**Delivery:**

Project Reports of the practice. Represents 15% of the final evaluation.

**Full-or-part-time:** 15h

Theory classes: 10h

Self study: 5h



### Activity 2: Examination 1st part

**Description:**

Individual examination and written about the contents of the modules 3,4,5.

**Specific objectives:**

Check the knowledge acquired in the theory sessions of these modules.

**Material:**

Atenea notes platform.

**Delivery:**

Individual exam. This exam can be recovered during the execution of the final exam. Represents 30% of the final grade for the course.

**Full-or-part-time:** 21h

Theory classes: 6h

Self study: 15h

### Activity 3: Work home

**Description:**

Performing the railway problems.

**Specific objectives:**

Check the knowledge acquired in the subject.

**Material:**

Atenea notes platform.

**Delivery:**

Portfolio. It represents 25% of the final grade for the course.

**Full-or-part-time:** 14h

Theory classes: 4h

Self study: 10h

### Activity 4: Final examination

**Description:**

Individual exam and written about the contents of the modules 6,7,8,9,10.

**Specific objectives:**

The exam must demonstrate that the student has acquired and assimilated the concepts, principles and fundamentals related to all these modules.

**Material:**

Atenea notes platform.

**Delivery:**

The deliverable will be the resolution of the exam.

Represents 30% of the final grade for the course.

**Full-or-part-time:** 25h

Theory classes: 10h

Self study: 15h



## GRADING SYSTEM

---

The final grade depends on the following evaluative acts:

- Activity 1 (project), weight: 15%
- Activity 2 (Exam 1st parc) weight: 30%
- Activity 3 (portfolio) weight: 25%
- Activity 4 (final exam), weight: 30%

Activity 1 will be performed in groups and shall be in writing on the project.

Activity 2 will be performed individually in person and in writing.

Activity 3 will be held individually and delivered by Atenea.

Activity 4 will take place individually in person and in writing.

In the activity 2 it will be possible to redirect the result if the result is unsatisfactory (less than 5) presenting a recovery on the day of the final evaluation (final exam), in the same time.