

## 30151 - Missiles

### Syllabus Information

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**Academic Year:** 2019/20

**Subject:** 30151 - Missiles

**Faculty / School:** 179 - Centro Universitario de la Defensa - Zaragoza

**Degree:** 457 - Bachelor's Degree in Industrial Organisational Engineering  
563 - Bachelor's Degree in Industrial Organisational Engineering

**ECTS:** 6.0

**Year:** 4

**Semester:** First semester

**Subject Type:** Optional

**Module:** ---

## 1.General information

### 1.1.Aims of the course

**This course and its expected learning results obeys to the next objectives and plans.**

There is a double approach: theoretical and applied. The aim is that the student can acquire the required competences to understand the design, basics and operation of any kind of missile; as well as the capacity to evaluate the performance of a specific missile system and to analyze its suitability for a particular combat application.

### 1.2.Context and importance of this course in the degree

The course on Missiles is an optional subject which makes part of the module of Military Training in the Fundamental Specialty of Artillery, which is part of the degree in Industrial Organization Engineering. Its main aim is that the graduate can develop a professional technical profile in units of the Artillery Arm, as well as in any other position which may require the knowledge of its contents.

In order to achieve a proper understanding of the subject, use will be made of competences previously acquired during the degree. In particular, those provided by the subjects on Mathematics and Physics during the two first courses of the degree, as well as those corresponding to the subjects on Mechanics and Control Systems.

### 1.3.Recommendations to take this course

This subject is a fourth-year one, according to the degree structure, and corresponds to a Fundamental Specialty. In a missile system, use is made of a wide range of technologies which have been previously studied in other subjects of the degree in most cases. According to that, any fourth-year student should be able to successfully complete the subject. Throughout the course some new concepts, not previously studied, will be introduced as they are needed to properly understand the operation of a missile; however, they are not expected to create any special difficulty since new concepts will be clarified and strengthened at class dissertations.

## 2.Learning goals

### 2.1.Competences

After successfully completing this subject, the student will be more competent to ...

#### GENERIC COMPETENCES

C02 - Ability to plan, budget, organise, manage and monitor tasks, people and resources.

C04 - Ability to solve problems and take decisions with initiative, creativity and critical reasoning.

C06 - Ability to communicate knowledge and skills in Spanish.

C09 - Ability to work in a multidisciplinary group and in a multilingual setting.

C11 - Ability to continue learning and develop self-learning strategies.

#### SPECIFIC COMPETENCES

C58 - Familiarity with the fundamentals of Mathematics, Ballistic and Guided Missile Systems applicable to firing procedures for Artillery Weapons Systems.

## 2.2.Learning goals

**The student, to pass this subject, must prove the following achievements ...**

- Capacity to describe the different scientific subjects that are involved in the conception, design and operation of a missile and their relations with each other that may provide with an overview of the full system. Special emphasis will be made on the Guidance System.
- Technical competence to use and understand the information provided with existing missile systems, so that their possible use can be extracted. The student ...
  1. knows how to classify and analyze the different Guidance Systems of a missile (missile block diagram) and is able to identify its components.
  2. can analyze the functions performed by each component and how they affect the performance of the full missile system.
  3. knows how to classify and identify the different missile trajectories and its use by different missile systems.
  4. distinguishes the origin, factors and circumstances which intervene in the appearance of aerodynamical forces and knows to analyze how they are used.
  5. can analyze and identify Control Systems as a fundamental component of any missile in use by weapons systems.
  6. knows how to distinguish and analyze the different sensors and navigation systems of a missile: infrared sensor (IR), laser, inertial sensors (gyroscopes, accelerometers, IMU) and image processing.
  7. can analyze the components of an Unmanned Aircraft/Aerial Vehicle (UAV).

## 2.3.Importance of learning goals

**Relevance of the learning goals achieved through this subject**

Learning goals are a part of the competences that a student must acquire as a part of his formation in the Fundamental Specialty of his choice. In particular, they will provide him with the ability to extract, from the technical information about missile systems, those data more relevant to determine the possible uses of the system.

## 3.Assessment (1st and 2nd call)

### 3.1.Assessment tasks (description of tasks, marking system and assessment criteria)

#### 3.1. Type of tests and their value on the final grade and evaluation criteria for each test

The student will have to prove that he has achieved the expected learning goals by means of the following evaluation activities:

- 1) Continuous evaluation. It will be based in written and oral examinations as well as the preparation and exposition of essays about either theoretical, practical or theoretical-practical topics of the subject. It will be responsible for a 40% of the final rating.
- 2) Final evaluation. It will consist of an examination with a theoretical part made of either short answer questions or test questions and a practical part with application of the knowledge acquired to proposed examples. It will be responsible for a 60% of the final rating.

The qualification of CAPABLE will require a final rate greater than or equal to five. Those students who do not pass this mark will have to attend the official examination of the corresponding call. Students who may like to improve their final rating, though they have passed the subject, can attend the official examination of the corresponding call, too.

## 4.Methodology, learning tasks, syllabus and resources

### 4.1.Methodological overview

The methodology followed in this course is oriented towards the achievement of the learning objectives.

Teaching aimed at allowing students to learn by themselves. There will be either theory sessions, at which the teacher will explain the subject, or practice sessions, at which contents will be applied to problem resolution and case study tasks.

Under the guidance and coordination of the teacher, it is pretended that the student gets used to taking a critical stance of the information received; reasoning for himself and stimulating analysis and reflection. The teacher will pose questions with the aim that students be able, by themselves, to understand the operation of the different elements under scrutiny.

Self-study is essential in the learning process of the subject since students should get used to consulting several bibliographic sources in order to extract all the needed information.

### 4.2.Learning tasks

Learning planning activities used in conjunction to help students to achieve the objectives ...

- 1) Presential learning activities (60 hours), based on:
  - Theory sessions where the main concepts of the subject will be explained.

- Problem solving and case study where theory and bibliographical sources will be used.

2) No presential learning activities (90 hours), based on:

- Autonomous work of the student outside the class where he should solve problems and study the available theoretical documents to consolidate knowledge.

- Possible preparation of an autonomous work.

### 4.3.Syllabus

The course includes the following learning tasks:

- Topic I. Introduction to missile systems.
- Topic II. Introduction to guidance and control systems.
- Topic III. Fundamentals of Aerodynamics and Structural Design.
- Topic IV. Mechanics of Flight.
- Topic V. Control systems.
- Topic VI. Missile-objective kinematics.
- Topic VII. Navigation systems.
- Topic VIII. Thermal radiation laws. Radiometry.
- Topic IX. Infrared sensor: principles of operation and components.
- Topic X. Laser: principles of operation and control techniques.
- Topic XI. Introduction to Unmanned Aerial Vehicles (UAV).

### 4.4.Course planning and calendar

#### Learning planning activities in hours

	Class hours	Outside class hours	Total hours
Masterly lesson	46	-	46
Problems/exercises solving	4	10	14
Mixed tests	6	-	6
Final exam	4	-	4
Personal learning work	-	80	80
<b>TOTAL HOURS</b>	<b>60</b>	<b>90</b>	<b>150</b>

(\*) The planning table in hours is estimated, considering the homogeneity of the students.

(\*\*) Mixed tests include short writes, oral tests, and possible papers. The hours not used in this section will be distributed in the other sections as needed.

#### Class sessions scheduling and delivering possible papers

It will be announced by the teacher in class and in the web address <https://moodle2.unizar.es/add/>

### 4.5.Bibliography and recommended resources

[http://biblos.unizar.es/br/br\\_citas.php?codigo=30151&year=2019](http://biblos.unizar.es/br/br_citas.php?codigo=30151&year=2019)