

## 30151 - Missiles

### Información del Plan Docente

Academic Year	2016/17
Academic center	179 - Centro Universitario de la Defensa - Zaragoza
Degree	563 - Bachelor's Degree in Industrial Organisational Engineering 457 - Bachelor's Degree in Industrial Organisational Engineering
ECTS	6.0
Course	4
Period	First semester
Subject Type	Optional
Module	---

### 1.Basic info

#### 1.1.Recommendations to take this course

#### 1.2.Activities and key dates for the course

### 2.Initiation

#### 2.1.Learning outcomes that define the subject

#### 2.2.Introduction

### 3.Context and competences

#### 3.1.Goals

#### 3.2.Context and meaning of the subject in the degree

#### 3.3.Competences

#### 3.4.Importance of learning outcomes

### 4.Evaluation

### 5.Activities and resources

#### 5.1.General methodological presentation

##### Learning process based on...

Aimed at teaching students to learn by himself. Classes consist of theoretical and practical presentation of the contents by the teacher, interspersed with dialogue and participatory arguments on the questions, comments and curiosities that arise bidirectionally (by the teacher or students). Punctually it is devoted time to perform some tasks in small groups. Masterly lessons method used by the teacher will be reduced to the minimum necessary for the explanation of the content difficult to understand for students. It will be under the guidance and coordination of the teacher, the student gets used to

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take positions critical of the information received, reasoning itself and stimulating analysis and reflection. The self-study student is essential in the learning process of the subject.

Teaching aids will rely on the use of presentations and videos, as well as the use of the blackboard.

### 5.2.Learning activities

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

**1) Active learning activities** (60 hours), based on:

- Masterly lessons, in order to provide the necessary basic concepts of each unit, nearly all students could reach a high level of achievement.

- Active work of the students individually or in small groups, using the bibliography and other additional information.

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

- Autonomous work of the student outside class, necessary to contribute to development their skills and to achieve the learning outcomes of the programme.

- Possible development of a paper in small groups.

### 5.3.Program

Contents of the subject

#### **UNIT 1: PROPULSION, CONTROL, GUIDANCE AND NAVEGATION SYSTEMS** (80% of the subject)

Chapter I. Introduction to principles of guided missiles.

Chapter II. Propulsion system. Propulsion force.

Chapter III. Fundamental Aerodynamic and structural design principles.

Chapter IV. Airframe and control system.

Chapter V. Stability and manoeuvrability design principles.

Chapter VI. Guidance system.

Chapter VII. Kinematic equations missile-objective. Trajectories.

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Chapter VIII. Guidance order. Guidance laws for guided missiles.

Chapter IX. Navigation guidance: inertial and GPS navigation.

### **UNIT 2: INFRARED AND LASER ELECTROMAGNETIC SPECTRUM** (12% of the subject)

Chapter X. Radiation physics. Radiometry.

Chapter XI. Infrared sensor: principles of operation and components.

Chapter XII. Laser: Introduction to principles of operation and control techniques.

### **UNIT 3: UAV SYSTEM** (8% of the subject)

Chapter XIII. Introduction, classification and flight architecture.

Chapter XIV. Guidance, navigation and control systems.

Chapter XV. PAYLOAD: thermal and visible imaging systems and synthetic aperture radar.

## **5.4.Planning and scheduling**

### **Learning planning activities in hours**

	Class hours	Outside class hours	Total hours
Masterly lesson	46	-	46
Problems / exercises solving	4	4	8
Mixed tests	8	-	8
Final exam	2	-	2
Personal learning work	-	86	86
<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**

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

### 5.5.Bibliography and recommended resources

**BB** ACART-VA-005: Fundamentos Láser (Manual de la Academia de Artillería)

**BB** ACART-VA-010: Misiles II: Infrarrojos (Manual de la Academia de Artillería)

**BB** ACART-VA-011: Misiles III. Sistemas de guía y control (Manual de la Academia de Artillería)

**BB** Apuntes de Misiles. Madrid: Departamento de Técnica Militar, 2015

**BB** Cucharero Pérez. Guiado y control de misiles. Madrid: Ministerio de Defensa, 1995

**BB** Houghton, Edward Lewis. Aerodynamics for engineering students E.L. Houghton, N.B. Carruthers . - 3rd. ed. London : Edward Arnold, 1982

**BB** Kermode, A.C. Mechanics of flight. 11th ed. Harlow, Pearson/Prentice Hall, 2006

**BC** Blakelock, John. Automatic Control of aircraft and missiles, . 2nd ed. Wiley-Interscience, 1991

**BC** Phillips, Warren. Mechanics of flight / Warren Phillips. New Jersey: John Wiley & Sons, 2010

**BC** Stevens, Brian L. Aircraft control and simulation / Brian L. Stevens & Lewis . Hoboken: John Wiley & Sons, 2003