Course guide

**220343 - 220343 - Advanced Propulsion**

**Unit in charge:** Terrassa School of Industrial, Aerospace and Audiovisual Engineering

**Teaching unit:** 220 - ETSEIAT - Terrassa School of Industrial and Aeronautical Engineering.

**Degree:**
- MASTER'S DEGREE IN AERONAUTICAL ENGINEERING (Syllabus 2014). (Optional subject).
- MASTER'S DEGREE IN SPACE AND AERONAUTICAL ENGINEERING (Syllabus 2016). (Optional subject).

**Academic year:** 2022  **ECTS Credits:** 5.0  **Languages:** English

**LECTURER**

**Coordinating lecturer:** Manel Soria Guerrero

**Others:**

**PRIOR SKILLS**

Previous concepts include knowledge of Thermodynamics and Propulsion systems for aircraft and spacecraft, given in any bachelor’s degree in aerospace engineering and reviewed in previous subjects of this Master’s degree, as well as familiarity with the use of computing tools for engineering. Good knowledge of at least one computer language (C, Matlab, Python..) is required, as most of the exercises involve code development and verification.

**DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES**

**Specific:**
- CEEPROP1. MUEA/MASE: Sufficient applied knowledge of aspects of measurement, calculation and numerical resolution in experimental and computational aerodynamics (specific competency for the specialisation in Propulsion).
- CEEPROP2. MUEA/MASE: Advanced applied knowledge of the design, manufacture and maintenance of propulsion systems (specific competency for the specialisation in Propulsion).

**TEACHING METHODOLOGY**

Lectures and hands-on sessions to solve problems with the help of computers.

**LEARNING OBJECTIVES OF THE SUBJECT**

- Understand the fundamental principles and the limitations of advanced propulsion technologies.
- Understand the key practical issues associated with the testing of new propulsion and energy storage devices.
- Have adequate knowledge of the current state of electric propulsion for manned and unmanned aircraft, its potential and limitations.

**STUDY LOAD**

<table>
<thead>
<tr>
<th>Type</th>
<th>Hours</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hours large group</td>
<td>30,0</td>
<td>24.00</td>
</tr>
<tr>
<td>Hours small group</td>
<td>15,0</td>
<td>12.00</td>
</tr>
<tr>
<td>Self study</td>
<td>80,0</td>
<td>64.00</td>
</tr>
</tbody>
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**Total learning time:** 125 h
## CONTENTS

### Module 1: Introduction to electric aircraft

**Description:**
- History, scope and advantages of electric propulsion.
- Tools for preliminary design.
- Aerodynamics of propellers.
- Introduction to electric motors for aircraft.

**Full-or-part-time:** 41h
- Theory classes: 10h
- Practical classes: 5h
- Self study: 26h

### Module 2: Batteries for aerospace applications

**Description:**
- Energy storage: technologies, capacity, charge/discharge cycles, safety, practical aspects.
- Models for Lithium-Ion batteries.
- Case study: manned and unmanned aircraft with electric propulsion.
- Case study: perpetually flying machines.
- Case study: the Dragonfly mission to Titan.
- Case study: the Ingenuity Drone on Mars.

**Full-or-part-time:** 41h
- Theory classes: 10h
- Practical classes: 5h
- Self study: 26h

### Module 3: Project

**Description:**
- Working in groups, the students will carry out the preliminary design of a fully electric aircraft. They must consider all the propulsion system (batteries, propellers, wiring, cooling systems, etc). They are expected to develop software tools in order to analyse different design variants.

**Full-or-part-time:** 43h
- Theory classes: 10h
- Practical classes: 5h
- Self study: 28h

## GRADING SYSTEM

- Class participation and class exercises: 30%
- Assignments: 30%
- Project: 40%

Students with a grade below 5 in the project, or the assignments, or the classroom participation, will be able to take an additional written exam covering all the subject, which will take place on the date fixed in the calendar of final exams. The grade obtained in this exam will range between 0 and 10, and will replace the part or parts below 5 only in case it is higher, up to a maximum of 5 points.
BIBLIOGRAPHY

Basic: