

## 205217 - EM - Electromobility and Electrical Aircraft Systems

Coordinating unit: 205 - ESEIAAT - Terrassa School of Industrial, Aerospace and Audiovisual Engineering  
Teaching unit: 709 - EE - Department of Electrical Engineering  
Academic year: 2019  
Degree: BACHELOR'S DEGREE IN INDUSTRIAL TECHNOLOGY ENGINEERING (Syllabus 2010). (Teaching unit Optional)  
BACHELOR'S DEGREE IN AEROSPACE TECHNOLOGY ENGINEERING (Syllabus 2010). (Teaching unit Optional)  
BACHELOR'S DEGREE IN AEROSPACE VEHICLE ENGINEERING (Syllabus 2010). (Teaching unit Optional)  
BACHELOR'S DEGREE IN INDUSTRIAL ELECTRONICS AND AUTOMATIC CONTROL ENGINEERING (Syllabus 2009). (Teaching unit Optional)  
BACHELOR'S DEGREE IN ELECTRICAL ENGINEERING (Syllabus 2009). (Teaching unit Optional)  
BACHELOR'S DEGREE IN MECHANICAL ENGINEERING (Syllabus 2009). (Teaching unit Optional)  
BACHELOR'S DEGREE IN CHEMICAL ENGINEERING (Syllabus 2009). (Teaching unit Optional)  
BACHELOR'S DEGREE IN TEXTILE TECHNOLOGY AND DESIGN ENGINEERING (Syllabus 2009). (Teaching unit Optional)  
BACHELOR'S DEGREE IN INDUSTRIAL DESIGN AND PRODUCT DEVELOPMENT ENGINEERING (Syllabus 2010). (Teaching unit Optional)  
ECTS credits: 3 Teaching languages: English

### Teaching staff

Coordinator: Jordi-Roger Riba

### Teaching methodology

The course is developed through lectures including theoretical sessions imparted with the aid of powerpoint presentations and more applicative and more visual sessions with videos, stellar catalogues and simulations

### Learning objectives of the subject

The main objective of the course is to introduce students into theoretical and practical aspects of electromobility, with special emphasis on more electrical aircrafts. Students after this course should be able to identify and understand the different electrical and electronic systems used in electromobility applications such as hybrid and electrical vehicles and aircrafts.

Additionally, some aspects related to energy storage systems, electrical machines technology, power converters, energy efficiency, power density, carbon footprint or life cycle assessment will also be considered.

Capabilities to be acquired by the student: English language, team work, autonomous learning, solvent use of information resources.



## 205217 - EM - Electromobility and Electrical Aircraft Systems

### Study load

|                          |                     |     |        |
|--------------------------|---------------------|-----|--------|
| Total learning time: 75h | Hours large group:  | 30h | 40.00% |
|                          | Hours medium group: | 0h  | 0.00%  |
|                          | Hours small group:  | 0h  | 0.00%  |
|                          | Guided activities:  | 0h  | 0.00%  |
|                          | Self study:         | 45h | 60.00% |

## 205217 - EM - Electromobility and Electrical Aircraft Systems

### Content

|  |  |
|--|--|
| <p>Module 1: Introduction</p>  | <p>Learning time: 5h<br/>Theory classes: 2h<br/>Self study : 3h</p>  |
| <p>Description:</p> <ul style="list-style-type: none"> <li>- Brief history</li> <li>- Overview</li> <li>- Basic principles</li> <li>- Electromobility: current status and future trends</li> <li>- Trends of more electrical aircrafts</li> </ul> <p>Related activities:</p> <ul style="list-style-type: none"> <li>- Theoretical sessions</li> <li>- Activities in class. Activity 1</li> </ul> |  |
| <p>Module 2: Energy storage and power sources</p>  | <p>Learning time: 10h<br/>Theory classes: 4h<br/>Self study : 6h</p> |
| <p>Description:</p> <ul style="list-style-type: none"> <li>- Batteries</li> <li>- Fuel-cells</li> <li>- Plug-in systems</li> <li>- Lifetime costs</li> </ul> <p>Related activities:</p> <ul style="list-style-type: none"> <li>- Theoretical sessions</li> <li>- Activities in class. Activity 2</li> </ul>  |  |

## 205217 - EM - Electromobility and Electrical Aircraft Systems

|  |   |
|--|---|
| <p>Module 3: Brushless electric motors and generators</p>  | <p>Learning time: 22h 30m<br/>Theory classes: 9h<br/>Self study : 13h 30m</p> |
| <p>Description:</p> <ul style="list-style-type: none"> <li>- Generator and motor principles</li> <li>- AC generators for aircrafts</li> <li>- Three-phase generation and distribution in aircrafts</li> <li>- Brushless AC motors</li> </ul> <p>Related activities:</p> <ul style="list-style-type: none"> <li>- Theoretical sessions</li> <li>- Practical sessions: Simulations</li> <li>- Activities in class. Activity 3</li> </ul>   |   |
| <p>Module 4: Power conversion and electronic DC/DC regulation</p>  | <p>Learning time: 22h 30m<br/>Theory classes: 9h<br/>Self study : 13h 30m</p> |
| <p>Description:</p> <ul style="list-style-type: none"> <li>- Transformers</li> <li>- Transformer-rectifier units (TRU)</li> <li>- Inverters</li> <li>- DC-DC power converters</li> <li>- Filters</li> <li>- Auxiliary power unit (APU)</li> <li>- Emergency power</li> <li>- Distribution of power supplies</li> </ul> <p>Related activities:</p> <ul style="list-style-type: none"> <li>- Theoretical sessions</li> <li>- Practical sessions: Simulations</li> <li>- Activities in class. Activity 4</li> </ul> |   |

## 205217 - EM - Electromobility and Electrical Aircraft Systems

|  |  |
|--|--|
| <p>Module 5: The more electrical aircraft: next generation aircraft power</p>  | <p>Learning time: 10h<br/>Theory classes: 4h<br/>Self study : 6h</p> |
| <p>Description:</p> <ul style="list-style-type: none"> <li>- Full view of the electrical and electronic system of MEA</li> <li>- Towards high-voltage systems</li> <li>- Operating environment</li> <li>- Wiring, insulation materials, and circuit protection</li> </ul> <p>Related activities:</p> <ul style="list-style-type: none"> <li>- Theoretical sessions</li> <li>- Activities in class. Activity 5</li> </ul> |  |
| <p>Module 6: Environment aspects and life cycle assessment (LCA)</p>   | <p>Learning time: 5h<br/>Theory classes: 2h<br/>Self study : 3h</p>  |
| <p>Description:</p> <ul style="list-style-type: none"> <li>- Principles of LCA</li> <li>- Application to all electric and hybrid vehicles</li> <li>- Application to aircraft systems</li> </ul> <p>Related activities:</p> <ul style="list-style-type: none"> <li>- Theoretical sessions</li> <li>- Activities in class. Activity 6</li> </ul>   |  |

### Qualification system

The qualification of the subject is divided in two parts:

Guided project: 40%

Written mid-term exam: 20%

Written final exam: 40%

The guided project will be handed over at the end of the subject.

All modules will be covered between the written mid-term and final exams. They will be done at mid-term and the end of the subject, respectively.

$$\text{Final\_Mark} = 0.2 \cdot \text{Exam\_Mid-Term\_Grade} + 0.4 \cdot \text{Exam\_Final\_Grade} + 0.4 \cdot \text{Guided\_Project\_Grade}$$

Any student who cannot attend any of the written exams or that wants to improve the grade obtained, will have the re-conduction possibility. It is an additional global written exam that will take place the dated fixed in the final exams calendar. The grade obtained in this exam will replace that of the previous exams only in case it is higher.



## 205217 - EM - Electromobility and Electrical Aircraft Systems

### Bibliography