



## TECHNICAL SHEET OF THE SUBJECT

Data of the subject	
Subject name	Design of electrical prototype
Subject code	DIE-OPT-421
Involved programs	Grado en Ingeniería en Tecnologías Industriales [Fourth year]
Level	Reglada Grado Europeo
Quarter	Semestral
Credits	3,0 ECTS
Type	Optativa (Grado)
Department	Department of Electrical Engineering
Coordinator	Fidel Fernández Bernal / Pablo Esparza Ibáñez
Schedule	To be defined
Office hours	To be defined

Teacher Information	
<b>Teacher</b>	
Name	Fidel Fernández Bernal
Department	Department of Electrical Engineering
Office	Alberto Aguilera 25
EMail	Fidel.Fernandez@iit.comillas.edu
Phone	2385
<b>Teacher</b>	
Name	Pablo Esparza Ibáñez
Department	Department of Electrical Engineering
EMail	pesparza@icai.comillas.edu

## SPECIFIC DATA OF THE SUBJECT

### Contextualization of the subject

### Competencies - Objectives

#### Learning outcomes

1. Be able to identify and characterize all the main components found in an electric powertrain.
2. Know the general safety regulations for racing electric vehicles.
3. Know how to test electric powertrain components focussing on key parameters.
4. Understand the charging and discharging process of a lithium battery. Understand how Battery management systems are designed.



5. Know different electric motors typologies and its advantages or disadvantages
6. Understand how electric motors are controlled by the inverters.
7. Understand how telemetry systems work and how to use the logged data to understand vehicle behaviour and improve its performance.

## THEMATIC BLOCKS AND CONTENTS

### Contents - Thematic Blocks

#### Introducción

General understanding of main electric vehicle components. Chassis, transmission, steering, suspension, brakes, cooling systems, electric motor, inverter, battery, BMS and data loggers. :

#### Module 1: Safety and regulations.

Formula Student Regulations, Motostudent regulations, connectors, wiring harnesses.

#### Module 2: Battery and battery management systems.

Cell types (cylindrical, prismatic and pouch) and cell characterization. Battery pack design and cooling systems.

#### Module 3: Electric motor, inverter and control.

Electric motors typologies. Basic inverter architecture. Motor vector control using d and q axis. Human to inverter and inverter to motor calibration.

#### Module 4: Telemetry and data logging.

Data logging hardware and basic principles. Understand vehicle behaviour and improve vehicle performance using data.

## TEACHING METHODOLOGY

### General methodological aspects of the subject

#### In-class Methodology: Activities

General explanation of the main contents.

Open discussion about practical examples and design challenges.

#### Non-Presential Methodology: Activities

Study of main contents of the subject. Individual activity reviewing class information.

Reading or viewing of the complementary resources analysing and understanding the exposed information.

Use acquired knowledge to design vehicles for international competitions (mainly Formula Student and MotoStudent)



## EVALUATION AND CRITERIA

### Final Exam

Class attendance is mandatory according to Article 93 of the General Regulations (Reglamento General) of Comillas Pontifical University and Article 6 of the Academic Rules (Normas Académicas) of the ICAI School of Engineering. Not complying with this requirement may have the following consequences: - Students who fail to attend more than 15% of the lectures may be denied the right to present the term task during the regular assessment period.

Students who commit an irregularity in any graded activity will receive a mark of zero in the activity and disciplinary procedure will follow (cf. Article 168 of the General Regulations (Reglamento General) of Comillas Pontifical University).

## Ratings

Final Exam: 100%

Class attendance is mandatory according to Article 93 of the General Regulations (Reglamento General) of Comillas Pontifical University and Article 6 of the Academic Rules (Normas Académicas) of the ICAI School of Engineering. Not complying with this requirement may have the following consequences: - Students who fail to attend more than 15% of the lectures may be denied the right to present the term task during the regular assessment period.

Students who commit an irregularity in any graded activity will receive a mark of zero in the activity and disciplinary procedure will follow (cf. Article 168 of the General Regulations (Reglamento General) of Comillas Pontifical University).

## BIBLIOGRAPHY AND RESOURCES

### Basic Bibliography

All necessary documentation and resources will be available online.

### Complementary Bibliography

**WeberAuto:** Utah University. Videos of professor John D.Kelly explaining electric vehicles components (motors, inverters and batteries): <https://www.youtube.com/c/WeberAuto/videos>

**Munro:** Leading company into vehicles analysis and benchmarking: <https://www.youtube.com/c/MunroLive/videos>