ESCUELA TÉCNICA SUPERIOR
DE INGENIERÍA

GUÍA DOCENTE
CURSO 2017-2018

SUBJECT DATASHEET

Subject basic Information	
Name	Automotive Engines
Code	ALE01
Study	Grado en Ingeniería Electromecánica
Course	4º
Semester	2º
ECTS	3 ECTS
Type	Optativa Complementaria
Department	Ingeniería Mecánica
Area	Energía
University	Comillas
Timetable	
Teachers	Juan de Norverto Moriñigo
Descriptor	

Faculty information	
Teacher	
Name	Juan de Norverto Moriñigo
Departament	Ingeniería Mecánica
Área	Energía
Office	D-314
e-mail	jnorvert@comillas.edu
Students attention	To be defined at term beginning

SPECIFIC SUBJECT DATASHEET

Subject contextualisation

Contribution to the professional profile of the Title

This subject has been designed to complete the student knowledge about automotive engines, inside the Electromechanical engineer profile, going deep with the concepts already studied in other subjects in previous terms belonging to Thermal Engineering.

At the end of the season, the students will be able to predict engine performances, their relationship with vehicles and the response in a real journey with variable loads. Also emission regulations will be reviewed and the strengths and weaknesses of electrical / hybrid vehicles will be studied and compared with the same vehicles propelled with internal combustion engines.

This subject will explore both theory and praxis, so numerical models will be used to solve the basic equations of the internal combustion engines.

Pre requirements

There are not any pre requirement needed to study the subject. However basic thermodynamics knowledge will be a good asset. Example of this:

Thermodynamics
- Properties estimation.
- Energy balance.

Fluid Mechanics
- Compressible flow.
- Drag resistance.
- Hydraulic circuits

Heat transfer
- Heat transfer laws
- Heat exchangers

Competencies - Targets

General Competencies of the course / qualification

CG3.	Knowledge on basic and technological matters that help the learning of new method and theories. Student will be trained to be flexible in front of new challenges.
CG4.	Ability to solve new problems, make decisions, be creative, critical reasoning and to communicate knowledge and skills inside the Industrial Engineering field.
CG6.	Ability to handle regulations, specs, and mandatory standards,
CG7.	Ability to analyze and evaluate the environmental impact of these technical solutions.
CG10.	Ability to work and be active part of a multicultural and multidisciplinary team.

Learning outcome[1]
To learn about the main systems and components of an internal reciprocating combustion engine (ICE).
RA1. Main systems identification.
RA2. To understand the critical role of cooling and lubrication.
RA3. To use properly the technical vocabulary.
Basic Thermodynamic cycles analysis numerical resolution.
RA4. Basic processes identification of the Otto, Diesel, Atkinson, Miller cycles.
RA5. To understand the premises to model those cycle to represent the behavior of an ICE.
RA6. To understand the limits of the modeling and how to extend to real cycles.
To model the behavior of an ICE from their stationary curves obtained at test bench.
RA7. To learn how to model the engine and performances prediction.
RA8. Engine performances from test bench data.
RA9. To use simple modeling to predict engine behavior.
To obtain vehicle performances for a given engine.
RA10. Vehicle loads estimation and engine requirements to fulfill therm.
RA11. To predict vehicle performances with the engine curves and road conditions.
To understand causes and effects of the engine emissions.
RA12. To learn about how pollutants a created.
RA13. To identify strategies to reduce tail pipe emissions.
RA14. To understand the consequences on the environmental.
To learn about Hybrid vehicles.
RA15. To understand different configurations: series, parallel, complex.
RA16. To understand Hybrid vehicles role in the automotive market..
RA17. To understand different powertrain / energy reservoir configurations. (Petrol, Diesel, hydraulic …).
To learn about Electric vehicles.
RA18. State of the art.
RA19. Main components and technologies.
RA20. Use of simple range prediction models.
RA21. Market portfolio and vehicles available..

[1] Learning outcomes are indicators of the student competencies and internal deep knowledge.. The competencies are more general and abstract.. The R.A. are indicators showing student competencies.

THEME SEGMENT AND CONTENTS

Content – Theme segments
THEME 1: Reciprocating Engines
Unit 1: BASIC ENGINE DESIGN
1.1 Main components and systems. **1.2** Key systems (cooling, lubricating). **1.3** Engine glossary.
Unit 2: BASIC THERMODYNAMICS
2.1 Otto, Diesel and Atkinson cycles. **2.2** Review of the classic P-V cycles. From ideal to reality. Basic ratios.
Unit 3: ENGINE PERFORMANCE
3.1 Modeling and prediction. **3.2** Engine performance curves from fuel and air input. **3.3** Simple engine model and simulations.
Unit 4: LINK BETWEEN GROUND AND ENGINES
4.1 Aerodynamic drag. Grading resistance. Rolling resistance. **4.2** Vehicle performance predictions: máximum speed, acceleration, fuel consumption in a driving cycle.
Unit 5: EXHAUST EMISSIONS (tail pipe)
5.1 How pollutants are created. **5.2** How to prevent or reduce. Greenhouse effect. Acid Rain.
THEME 2 : Other powertrain
Unit 6: HYBRID VEHICLES.
6.1 Classification: Series, Parallel, Complex. **6.2** Vehicles for the future. From micro hybrids to plug-in. **6.3** Different architecture study. Petrol, diesel, hydralic.
Unit 7. ELECTRIC VEHICLES
7.1 Current state of the art. **7.2** Main components and technologies. **7.3** Range prediction & calculation. **7.4** Market solutions and today vehicles availability..

TRAINING METHODOLOGY

Subject methodological aspects

Both In-class and distance teaching are developed to imply the students within the learning activities. The subjects are developed to keep the student attention and following the competencies acquisition by the students. Student activities are key factors to develop this course.

In-class methodology: Activities

1. **Life presentations.** The teacher will explain basic concepts for every theme showing the more important aspects. Special attention to be paid with equations and how to use. Examples will be presented, discussed and solved to complete the understanding.
2. **In class case discussion and problem solving.** Students will discuss the cases and problems proposed by the teacher. Cases will be open challenges that can be analyzed and solved by the use of the concepts already presented in class.
3. **Team Work presentations.** The teacher will ask for team works of any proposed matter. Students will have to look for additional documentation to what was shown in class. Students must justify their conclusions and add value with their engineering mind. These works will be public presented in class.

Distance Methodology: Activities

1. **Self-learning** on the concepts presented in class. Material to be used are slides, multimedia files, personal and teacher notes, recommended books and magazines.
2. **Cases study**. To be revised and updated with the rest of information given in the subject.
3. **Team Works**. Preparation and presentation of team Works. Students must find the information sources to create outstanding works.

Main target of the distance Works is to be able to understand theoretical concepts and to be able to apply them.

STUDENT SCHEDULE SUMMARY (Hours)			
LIVE			
Teacher Lessons	Case discussion	Presentations	Evaluation
10	5	10	5
DISTANCE			
Self study on theory	Self work on cases	Prepare for Examination	Prepare for presentations
20	20	10	10
		ECTS:	3 (90 hours)

EVALUATION AND SCORING CRITERIA

Evaluation activities	Criteria	Weight
Tests:: • Mid term exam. • End of term exam	- Concepts understanding. - Use of concepts to solve real cases. - Problem solving solution analysis and results interpretation. - Presentation and written communication.	75%
Continuous evaluation.: • Case solving • Problems • Team work presentations	- Concepts understanding. - Concepts use to solve real cases.	25%

Scoring.

Scoring
The score for the **ordinary summon** will be obtained by: • 75% comes from exams scoring. End of term exam is 50% and mid-term is 25% of the total. • 25% comes from continuous evaluation. **Extraordinary summon** • 20% from the score obtained in continuous evaluation. • 80% from the extraordinary summon exam.

WORKING SCHEDULE

Distance Activities	Do Date	Delivery date
• Reading of multimedia files to be showed in class (Slides)	Before lesson	
• Study on the slides showed in class.	After lesson	
• Study with additional information coming from other sources: Hand written notes, books, etc.	After lesson	
• Problem solving	Before lesson	
• Solved problema understanding.	After lesson	
• Presentation, cases, problems preparation as part of continuous scoring.	At the end of the theme	
• Mid-term and final exam preparation.	February and April	

BIBLIOGRAFÍA Y RECURSOS

Bibliography

- Internal Combustion Engines Fundamentals, J.B. Heywood, Mc Graw-Hill, 1988

Aditional Bibliography

- Combustion Engines Development - G. Merker, et al., (Springer, 2012) BBS
- Automotive Fuel and Emission Ctl Systems 3rd ed - J. Halderman, J. Linder (Pearson, 2012) BBS
- Modern_Electric_Hybrid_Electric_and_Fuel_Cell_Vehicles, Ehsani, Gao, Gay, Emadi, CRC, 2004