Course guide
330529 - MTER - Thermal Motors

Last modified: 02/06/2023

Unit in charge: Manresa School of Engineering
Teaching unit: 750 - EMIT - Department of Mining, Industrial and ICT Engineering.

Degree: BACHELOR'S DEGREE IN AUTOMOTIVE ENGINEERING (Syllabus 2017). (Compulsory subject).

Academic year: 2023 **ECTS Credits:** 6.0 **Languages:** Catalan, Spanish

LECTURER

Coordinating lecturer: Felipe Blanch, Jose Juan De

Others: Felipe Blanch, Jose Juan De

Planells Torres, Mariano

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
CE2. Understanding and mastering the basic concepts of the general laws of mechanics, thermodynamics, fields and waves and electromagnetism and their application for solving engineering problems.
CE7. Knowledge of the basic principles of fluid mechanics and its application to problem solving in the field of engineering. Ability to design and interpret fluid dynamics systems.
CE16. Applied knowledge of industrial computing and communications in the automotive sector.

Generical:
CG1. Ability to write and develop projects in the field of automotive engineering for the construction, renovation, repair, maintenance, recycling, manufacture, installation, assembly or operation of: structures, mechanical equipment, energy installations, electrical and electronic installations, plants and industrial plants and manufacturing and automation processes.
CG2. Capacity for management of the activities that are the subject of the engineering projects described in the previous section.
CG4. Ability to solve problems with initiative, decision-making, creativity, critical reasoning and to communicate and transmit knowledge, skills and skills in the field of automotive engineering.
CG6. Ability to handle specifications, regulations and mandatory standards, as well as the specific legislation applicable to this area.
CG7. A capacity for analysing and assessing the social and environmental impact of technical solutions.

Transversal:
2. EFFICIENT ORAL AND WRITTEN COMMUNICATION - Level 3. Communicating clearly and efficiently in oral and written presentations. Adapting to audiences and communication aims by using suitable strategies and means.
4. SELF-DIRECTED LEARNING - Level 3. Applying the knowledge gained in completing a task according to its relevance and importance. Deciding how to carry out a task, the amount of time to be devoted to it and the most suitable information sources.
1. SUSTAINABILITY AND SOCIAL COMMITMENT - Level 2. Applying sustainability criteria and professional codes of conduct in the design and assessment of technological solutions.
03 TLG. THIRD LANGUAGE. Learning a third language, preferably English, to a degree of oral and written fluency that fits in with the future needs of the graduates of each course.
08 GEN. GENDER PERSPECTIVE: An awareness and understanding of sexual and gender inequalities in society in relation to the field of the degree, and the incorporation of different needs and preferences due to sex and gender when designing solutions and solving problems.

Basic:
CB1. Students will be able to demonstrate their knowledge of a field of study that builds on secondary education and is usually found at a level that, while supported by advanced textbooks, also includes aspects that involve knowledge of the latest developments in the field of study.
CB2. Students will be able to apply their knowledge to their work or vocation in a professional manner and demonstrate that they possess the competencies that are typically demonstrated by elaborating and defending arguments and solving problems in the field of study.
CB3. That students have the ability to gather and interpret relevant data (usually within their area of study) to make judgments that include a reflection on relevant social, scientific or ethical issues.

TEACHING METHODOLOGY

MD1 Masterclass or conference (EXP)
MD2 Problem solving and case studies (RP)
MD3 Laboratoru practices (TP)
MD5 Project, activity or work of reduced scope (PR)
MD7 Assessment activities (EV)

LEARNING OBJECTIVES OF THE SUBJECT

The learning objectives of the course are:
The application of the principles of thermodynamics to the study of thermal engines, especially those applied to the automotive industry.
2.- Mastery of the different variables and design parameters of Thermal Engines applied in Automotive.
3.- Mastery of the different variables and parameters of management and operation of Thermal Engines applied in Automotive.
4.- To know and understand the complexity of the economic and social phenomena typical of the welfare society, to have the capacity to relate welfare with globalization and sustainability; to reach skills to use in a balanced and compatible way the technique, technology, economy and sustainability.

STUDY LOAD

Type	Hours	Percentage
Hours small group	30,0	20.00
Self study	90,0	60.00
Hours large group	30,0	20.00

Total learning time: 150 h

CONTENTS

Introduction to Thermal Machines and their operating principles.

Description:
Introduction to Thermal Machines and their operating principles.

Specific objectives:
Definition and classification of Thermal Machines.
Second Law of Thermodynamics.
Carnot cycle.
Energy.
Basic cycles of power.

Related activities:
Individual Assessment (Activity 7)

Full-or-part-time: 15h
Theory classes: 6h
Self study : 9h

Energy Sources. Combustion and fuels for MACI (Alternative Internal Combustion Engines)

Description:
Primary energy sources, energy transformations Combustion and fuels for Alternative Internal Combustion Engines.

Specific objectives:
To know the main energy sources and energy transformations.
To understand the role of thermal machines in energy transformation.
Sustainability and social commitment, optimization and rational use of energy.
To understand the principles of combustion.
To understand the characteristics of the fuels for the different MACI typologies. Fuels alternative, biofuels and synthetic fuels.

Related activities:
Specific work on the contents (Activities 1, 2, 3, 4 and 5)
Individual Assessment (Activity7)

Full-or-part-time: 15h
Theory classes: 6h
Self study : 9h

Principles of operation of the MRCI (Rotating Internal Combustion Engines)

Description:
Study of rotary endothermic motors.

Specific objectives:
Study of the Bryton power cycle.
Study of the Gas Turbines.

Related activities:
Specific work on the contents (Activities 1, 2, 3, 4 and 5)
Individual Assessment (Activity 7)

Full-or-part-time: 15h
Theory classes: 6h
Self study : 9h

Principles of operation of MACI (Alternative Internal Combustion Engines)

Description:
Study of Alternative Internal Combustion Engines.

Specific objectives:
Know the operating principles of the 2T and 4T engines.
To know the theoretical Otto, Diesel and Sabathé cycles.
To know the real cycles of the MEP and the MEC.
To know the main variables and operating parameters of a MACI.

Related activities:
Specific work on the contents (Activities 1, 2, 3, 4 and 5)
Individual assessment (Activity 7)

Full-or-part-time: 15h
Theory classes: 6h
Self study : 9h

Pollutant emissions. Applicable regulations.

Description:
Study of pollutant emissions from MACIs

Specific objectives:
To know the emissions of gas and polluting particles emitted by MACIs.
To know the systems of reduction and mitigation of the polluting emissions of the MACI.
Know the systems for reducing and mitigating pollutant emissions from MACIs.
Know the regulations that govern the approval process as well as the operation during the life of vehicles with MACI.

Related activities:
Specific work on the contents (Activities 1, 2, 3, 4 and 5)
Individual Assessment (Activity 7)

Full-or-part-time: 10h
Theory classes: 4h
Self study : 6h

ACTIVITIES

Laboratory Practice Motor Provoked Ignition (MEP)

Description:
Disassembly, verification and calculation of the main parameters of a spark ignition engine (MEP)

Specific objectives:
Know the different technologies involved in the design and construction of an MEP as well as its auxiliary systems.

Material:
Equipment of the Automotive Laboratory.
ATENEA digital campus documentation and bibliography.

Delivery:
3 % of the continuous assessment mark

Full-or-part-time: 15h
Laboratory classes: 6h
Self study: 9h

Parameters of a spark ignition engine (MEC)

Description:
Disassembly, verification and calculation of the main parameters of a spark ignition engine (MEC)

Specific objectives:
Know the different technologies involved in the design and construction of an MEP as well as its auxiliary systems.

Material:
Equipment of the Automotive Laboratory.
ATENEA digital campus documentation and bibliography.

Delivery:
3 % of the continuous assessment mark.

Full-or-part-time: 15h
Laboratory classes: 6h
Self study: 9h

Direct injection system of a MEP.

Description:
Simulation of a direct injection system of a MEP.

Specific objectives:
Know all the components, as well as their principles of operation, of a MEP's direct gasoline injection system.

Material:
Equipment of the Automotive Laboratory.
ATENEA digital campus documentation and bibliography.

Delivery:
3 % of the continuous assessment mark.

Full-or-part-time: 15h
Laboratory classes: 6h
Self study: 9h

Control variables of an MEP

Description:
Analysis of the variables and control parameters of an MEP. Emissions control.

Specific objectives:
Analysis of the main variables of a MEP by means of diagnostic equipment and gas analyser. Influence of the different operating and configuration parameters of the ECU. Identification of the codes of anomalies and malfunctions.

Material:
Equipment of the Automotive Laboratory.
ATENEA digital campus documentation and bibliography.

Delivery:
3 % of the continuous assessment mark.

Full-or-part-time: 15h
Laboratory classes: 6h
Self study: 9h

Test of a MEP on a test bench.

Description:
Obtaining the characteristic curves of an MEP using an engine test bench.

Specific objectives:
Performance and consumption tests on an engine test bench. Data acquisition, parameter control and obtaining the characteristic curves of a MEP.

Material:
Equipment of the Thermal Engine and Fluid Mechanics Laboratory.
ATENEA digital campus documentation and bibliography.

Delivery:
3 % of the continuous assessment mark.

Full-or-part-time: 5h
Laboratory classes: 2h
Self study: 3h

Case Study

Description:
Case study research work. Elaboration of a report and presentation of the results and conclusions, participation in a debate.

Specific objectives:
To study in depth innovative technologies, methodologies and processes applied to propulsion and motorization systems in the automotive sector.

Material:
ATENEA digital campus documentation and bibliography.

Delivery:
15 % of the continuous assessment mark.

Full-or-part-time: 13h
Laboratory classes: 4h
Self study: 9h

Knowledge test 1st partial

Description:
A multiple-choice test of the knowledge of the target subjects of the first part of the course as well as its competences, especially the transversal competence CT2 (Sustainability and Social Commitment) which will be evaluated in level 3.

Specific objectives:
To evaluate the knowledge studied during the first part of the course.
To evaluate the competencies studied during the first part of the course, especially the CT2 (Sustainability and Social Commitment).

Material:
ATENEA digital campus documentation and bibliography.

Delivery:
40 % of the continuous assessment mark.

Full-or-part-time: 1h
Theory classes: 1h

Knowledge test 2nd partial

Description:
A multiple-choice test of the knowledge of the target subjects of the second part of the així subject as well as its competences, especially the transversal competence CT2 (Sustainability and Social Commitment) which will be evaluated in level 3.

Specific objectives:
To evaluate the knowledge studied during the second part of the course.

Material:
ATENEA digital campus documentation and bibliography.

Delivery:
20 % of the continuous assessment mark.

Full-or-part-time: 1h
Theory classes: 1h

GRADING SYSTEM

The final grade is calculated with the following formula: Nfinal= 0.4 Nex1 + 0.2 Nex2 + 0.15 Ntp + 0.15 Nec + 0.1 Na

Nfinal: final grade.

Nex1: score of the 1st exam of the subject. It consists of application and theory exercises based on the knowledge of master classes, problem classes and practice classes.

Nex2: grade of the 2nd exam of the course. It consists of application and theory exercises based on the knowledge of master classes, problem classes and practice classes.

Ntp: qualification of activities of the practices. This qualification will be obtained according to the work and the result of the internship class and the correction of the work presented.

Nec: case study qualification. This grade will be obtained from the report, the common presentation and the discussion with the rest of the class.

Na: qualification based on attendance and participation in the theoretical sessions, debates and practices.

EXAMINATION RULES.

It is necessary to have done all the activities to pass the course.

BIBLIOGRAPHY

Basic:
- Agüera Soriano, José. Termodinámica lógica y motores térmicos. 6ª ed. mejorada. Madrid: Ciencia 3, DL 1999. ISBN 8486204984.
- Carreras Planells, Ramón; ; Calvo Larruy, Antonio. Motores de combustión interna : fundamentos. Barcelona: Edicions UPC, 1993. ISBN 8476533543.
- Moran, Michael J; Shapiro, Howard N. Fundamentos de termodinámica técnica [on line]. 2ª ed. Barcelona: Reverté, cop. 2004 [Consultation: 10/06/2022]. Available on: https://ebookcentral-proquest-com.recursos.biblioteca.upc.edu/lib/upcatalunya-ebooks/detail.action?docID=5635437. ISBN 8429143130.

Complementary:
- Payri González, Francisco; Desantes Fernández, José María. Motores de combustión interna alternativos. Valencia : Barcelona: Editorial UPV ; Reverté, cop. 2011. ISBN 9788429148022.

RESOURCES

Other resources:
Non-tabulated resources: Notes available in the ATENEA digital campus.
Audiovisual material: Presentations on the digital campus and links to videos and websites.