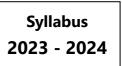


GENERAL INFORMATION

Data of the subject		
Subject name	Internal Combustion Alternative Engines	
Subject code	DIM-MII-531	
Mainprogram	Official Master's Degree in Industrial Engineering	
Involved programs	Máster Universitario en Ingeniería Industrial [First year]	
Level	Intercambio	
Quarter	Semestral	
Credits	4,5 ECTS	
Туре	Obligatoria	
Department	Department of Mechanical Engineering	

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DESCRIPTION OF THE SUBJECT

Contextualization of the subject		
Prerequisites		
There are no	t prerequisites strictly speaking. However, the subject is supported by some knowledges seen in previous subjects:	
• Ther	modynamics	
	• Mass and energy balances	
	Reciprocating engine fundamentals	
• Heat	t transfer	
	• Heat exchangers	
	Convection heat transfer	
• Fluid	d mechanics	
	• Flow in pipes (compressible and incompressible)	
	• Aerodynamic resistance	

Course contents

ontents	
omponents and systems	
nit 1: ICE classification	
1. Classification criteria and differencing characteristics.	
 Pundamental differences between compression ignition and spark ignition engines. Main application fields 	
3. Main application fields.	
nit 2: Constitutives elements	
1. The 5C: cylinder head, block, crankshaft, camshaft and connecting rod.	
2. Fundamental systems: lubrication and cooling.	
3. Other components.	
nit 7: Charge renovation. Volumetric efficiency and supercharging	
1. Parameters to characterise the charge renovation process.	
2. Pressure drop effect. Influence on pipes and valve design.	
3. Compresibility effect. Influence on the valve design.	
4. Flow inertia effect. Distribution diagram.	
5. Pressure waves effect. Design of manifolds.	

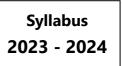
- 6. Warming-up effect.
- 7. Types of supercharging. Volumetric compressors, waves and turbochargers.
- 8. Supercharging effect.



1. Components.		
2. Phases of combustion i		
3. Typs of injection: indire		
4. Homogeneous and stra	-	
5. Anomalous combustior		
Unit 9: Injection and combusti	on in CI-engines	
1. Components.		
2. Phases of combustion i	CI.	
3. Anomalous combustion		
Unit 10: Exhaust process		
1. Exhaust system. compo	ients.	
2. Acoustic emissions at IC	Ε.	
Unit 11: Mechanical losses. Co	bling and lubrication.	
1. Energy balance of the e	ngine.	
2. Origin of mechanical lo	ses and estimation models.	
3. Energy recovery at ICE.		
Performance		
Unit 3: Fundamental equation	of ICE: Steady-state performance prediction model	
1. Power and torque pred	ction.	
2. Indicated and effective	parameters.	
3. Efficiencies.		
Unit 4: Performance curves: pa	rametric representation and outputs of ICE	
1. Tests in workbench.		
2. Full load curves.		
3. Partial load curves. Will	ns curve.	
Unit 5: Fundamental equation	of longitudinal dynamics of vehicles	
1. Forces over the vehicle:	aerodynamic, rolling and slope.	
2. Acceleration and consta	nt speed.	
3. Vehicle/engine coupling	•	

1. Cycle definition. Classification.





- 2. Phenomenological differences between actual and theoric cycles.
- 3. Theoric cycles of standard air.
- 4. Effect of cycle parameters.
- 5. Other theoric cycles.

Emissions and alternative propulsion

Unit 12: Polution and greenhouse effect. Reduction/supression systems

- 1. Gaseous emissions at SI.
- 2. Gaseous emissions aT Cl.
- 3. Active and passive reduction systems.
- 4. Current regulations: WLTP at workbench and on road.

Unit 12: Alternative solutions to ICEs: Hybridation, gas, electric, fuel cell

1. Hybrid and electric vehicles.

- 2. Unconventional fuels.
- 3. Advanced combustion Skyactiv X.

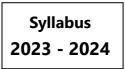
EVALUATION AND CRITERIA

Evaluation activities	Evaluation criteria	Weight
Exams. Problem or case study questions.	Both the procedure as numerical results will be taken into account. Results might be incorrect, but they should be coherent and logical.	28,5
Exams. Test questions.	Identification of the right answer among a limited set of options.	28,5
Reports of laboratory sessions	Both previous preparation as report from data collected in laboratory session will be assessed.	19
Team works (presented in classroom).	The team will show the topic developed in the report at classroom. Understanding and answers to questions from the audience will be assessed.	5
Team works (written report).	The report should be structured, including at least motivation, state of the art and own calculations.	19

Grading

Final grade is obtained as:





- 57% comes from exams grading. Final exam will contribute with 38% to the final grade of the subject, whereas mid term exam will contribute with 19%.
- 5% comes from presentations of the work teams in the classroom.
- 19% comes from the written report of the team works.
- 19% comes from the written reports of the laboratory sessions.

If the resulting average grade is higher than 5.0 the subject grade will be such average; otherwise, the subject grade will be the minimum grade between such average and the final exam grade.

Ordinary summon

Final grade is obtained as:

- 57% comes from exams grading. Final exam will contribute with 38% to the final grade of the subject, whereas mid term exam will contribute with 19%.
- 5% comes from the presentation of the team work in the classroom.
- 19% comes from the written report of the team work.
- 19% comes from the written report og the laboratory sessions.

If the resulting average grade is higher than 5.0 the subject grade will be such average; otherwise, the subject grade will be the minimum grade between such average and the final exam grade.

Extraordinary summon

Final grade is obtained as:

- 30% comes from the weighted average between the grade obtained in the work team (1/5) and the average grade of the reports of the laboratory sessions (4/5).
- 70% comes from the exam of the extraordinary summon.

If the resulting average grade is higher than 5.0 the subject grade will be such average; otherwise, the subject grade will be the minimum grade between such average and the exam grade.

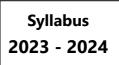
Rules

- Attendance (see latter) at work team and lab reports performing is a necessary condition to pass the subject in both summons.
- Neither programmable calculators nor formulae summary, books and notes are allowed. In the exams a self-made formulae summary with a maximum extension of two pages (one sheet by the two sides) is allowed.
- Attendance: The absence of more than 15% of the total amount of classes can entail to fail the ordinary summon.

WORK PLAN AND SCHEDULE

Activities	Date of realization	Delivery date
Reading and study of the theoretical contents (solides and test when available).	After each session.	





Proposed problems solving.	After finishing the corresponding unit.	
Mid term and final exam.	Week 8 and ordinary exams period.	
Mid term exam preparation.	At least weeks 7 and 8.	
Final exam preparation.	At least weeks 13, 14 and 15.	
Laboratory sessions attendance.	Weeks 11, 12, 13 and 14.	
Writting of reports from laboratory sessions.		Weeks 12, 13, 14 and 15.
Preparation of presentation.	Weeks 3 to 15.	
Participation in presentations.	Weeks 3 to 15.	

BIBLIOGRAPHY AND RESOURCES

Basic References

Notes and slides available at Moodle.

Complementary References

F. Payri, J.M. Desantes, Motores de combustión interna alternativos. Ed. Reverté, 2011.

In compliance with current regulations on the **protection of personal data**, we would like to inform you that you may consult the aspects related to privacy and data <u>that you have accepted on your registration form</u> by entering this website and clicking on "download"

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