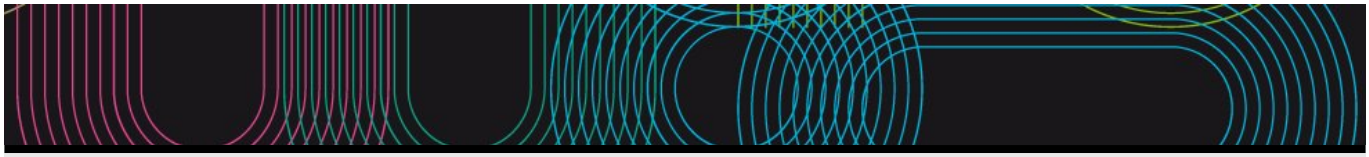

IDENTIFYING DATA				
Thermal technology				
Subject	Thermal technology			
Code	V12G363V01704			
Study programme	Grado en Ingeniería en Tecnologías Industriales			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	4th	1st
Teaching language	English			
Department				
Coordinator	Gómez Rodríguez, Miguel Ángel			
Lecturers	Gómez Rodríguez, Miguel Ángel			
E-mail	miguelgr@uvigo.es			
Web				
General description	In this subject, it is expected that the student adquire the essential knowledges that allow them to understand the operation of the thermal machines and the processes that take place in their interior, as well as that know the main types of machines and installations and their components. This knowledge results basic for the analysis of the operation, design and construction of the thermal machines and of their thermal setups, and in general, the industrial applications of the thermal engineering. The subject is focused on energy efficiency as well as environmental and social aspects. These are applied to systems using thermal cycles: power cycles (gas and steam) and in refrigeration and heat pump cycles, as well as the use of different renewable fuels.			

Training and Learning Results	
Code	
B4	CG4 Ability to solve problems through initiative, decision-making, creativity, critical reasoning, and to communicate and transmit knowledge, skills and abilities in the field of industrial engineering.
B5	CG5 Knowledge to carry out measurements, calculations, assessments, appraisals, surveys, studies, reports, work plans and other similar works.
B6	CG6 Capacity for handling specifications, regulations and mandatory standards.
B7	CG7 Ability to analyze and assess the social and environmental impact of the technical solutions.
B11	CG11 Knowledge, understanding and ability to apply the legislation relating to industrial installations.
C7	CE7 Knowledge of applied thermodynamics and heat transfer. Basic principles and their application to solving engineering problems.
D2	CT2 Problem solving.
D7	CT7 Ability to organize and plan.
D9	CT9 Application of knowledge.
D10	CT10 Self learning and work.
D17	CT17 Working as a team.
D20	CT20 Ability to communicate with people not expert in the field.

Expected results from this subject	Training and Learning Results		
Ability to know, understand, use and design energy systems by applying the principles and fundamentals of thermodynamics and thermostatic and fundamentals of thermodynamics and energy transmission.	B4 B5	C7	D2 D9
Understanding the fundamentals of combustion	B4 B5 B7	C7	D2 D7 D9

Understanding the fundamentals of heat engines	B4 B5 B7	C7	D2 D7 D9
Understanding the fundamentals of a thermal power plant operation	B4 B5 B6 B11	C7	D2 D9 D10 D17 D20

Contents	
Topic	
INTRODUCTION	1. Energy issues. Society and energy use 2. Energy production and consumption
HEAT EXCHANGERS	1. Classification of the heat exchangers 2. Calculation of the main parameters 3. Dimensioning 4. Method of the mean logarithmic temperature 5. Method E-NTU
COMBUSTION	1. Introduction 2. Types of combustion 3. Minimum or theoretical air 4. Excess combustion air 5. Combustion fumes 6. Incomplete combustion 7. Combustion diagrams 8. Combustion efficiency
HUMID AIR	1. Introduction 2. Moisture indices 3. Enthalpy of moist air 4. Dew point 5. Adiabatic saturation temperature 6. Wet bulb temperature 7. Psychrometric: Moist air diagrams 8. Mixing of two or more humid airs 9. Mixing of an air mass with water, steam and/or heat 10. Air conditioning processes
THERMAL MACHINES	1. Thermal machines. General 2. Rankine cycle 3. Rankine cycle with regeneration 4. Gas turbines 5. Burners 6. Boilers: definition and typology 7. Energy efficiency 8. Design of heat and water systems in buildings
POWER PLANTS TECHNOLOGY	1. Steam thermal power plant technology 2. Combined cycle power plant technology 3. Nuclear power plant technology 4. Cogeneration
AIR-CONDITIONING INSTALLATIONS	1. Introduction 2. Refrigeration cycle 3. Heat pump 4. Heat pump components 5. Operating characteristics 6. Design of air-conditioning systems 7. Energy efficiency
INTRODUCTION TO THERMAL ENGINES	1. Classification of internal combustion engines 2. Operation of reciprocating internal combustion engines 3. Parts of reciprocating internal combustion engines 4. Nomenclature and basic parameters 5. Theoretical cycles 6. Real cycles

Planning			
	Class hours	Hours outside the classroom	Total hours
Lecturing	20	21	41
Laboratory practical	4.5	0	4.5

Problem solving	8	14.5	22.5
Practices through ICT	2	0	2
Studies excursion	9	0	9
Mentored work	3	64	67
Problem and/or exercise solving	1	0	1
Essay questions exam	3	0	3

*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.

Methodologies

	Description
Lecturing	Classical lectures on the blackboard supported by slides, videos and any other material that the lecturer considers useful to make the any material that the teacher considers useful to make the subject matter of the course understandable
Laboratory practical	Performance of applied laboratory practices. The activities will consist of disassembling thermal engines, measuring thermal engines, measurement of emissions...
Problem solving	Exercises solving and case studies necessary for the preparation of theory classes
Practices through ICT	Solving exercises with the support of computer programmes
Studies excursion	Visits to installations to learn about the industrial level equipment explained in the lectures
Mentored work	Individual and/or group supervised work. This activity includes the presentation presentation of this work to the group and its subsequent evaluation

Personalized assistance

Methodologies	Description
Lecturing	Doubts statement during tutorial hours. The student will raise, during the time dedicated to to the tutorials, the doubts concerning the contents developed in the subject, and/or exercises or problems that arise concerning the application of the contents.
Laboratory practical	Raising doubts during practice hours. The student will raise, during the time dedicated to the doubts related to the concepts and development of the aforementioned practical sessions
Problem solving	Raising doubts during tutorial hours. The student will raise, during the time dedicated to tutorials, the doubts concerning the contents that are developed in the subject, and/or exercises or problems that arise relating to the application of the contents
Mentored work	The student will raise doubts during tutorials or in the classes dedicated to the preparation of the work regarding its preparation and the preparation and development of the work
Tests	**Description**
Problem and/or exercise solving	
Essay questions exam	

Assessment

	Description	Qualification	Training and Learning Results		
Mentored work	Delivery of the reports of the work carried out and oral presentation of the same. Resolution of problems raised during the course.	20	B4 B5 B6 B7 B11	C7	D2 D7 D9 D10 D17 D20
Problem and/or exercise solving	Partial exams taken along the course during class hours.	40	B4 B5 B6 B7 B11	C7	D2 D7 D9 D10 D17 D20
Essay questions exam	Final exam that will collect all the contents taught during the course. The exam will consist of problem solving and questions where both theoretical and practical content will be evaluated.	40	B4 B5 B6 B7 B11	C7	D2 D7 D9 D10 D17 D20

Other comments on the Evaluation

The coursecan be passed through two modalities:

A) Modality by Continuous Evaluation.

The final grade (FG) of the student will be determined by adding the points obtained in the successive activities of continuous assessment (problem solving with argued answer, test type test, test of objective questions, theoretical issues, etc.), both face-to-face and telematic, developed throughout the course. Each enrollment in the subject, in the course, implies the resetting to zero of the grades in the continuous evaluation activities obtained in previous courses. The students subject to the Continuous Evaluation modality who present themselves to any evaluable activity included in the Teaching Guide of the course will be considered as "presented" and will be taken into account for the final grade.

All school days will be considered susceptible and likely to include some continuous assessment activity. These activities will be notified sufficiently in advance, and will be carried out within the school timetable approved by the center, during the classroom sessions and/or problem and/or laboratory sessions that take place throughout the course. In case of insufficient means, the faculty will articulate the planning mechanism that guarantees the best adjustment to the schedule. The realization of these activities of continuous evaluation will be governed in time/conditions established by the professor.

There will be partial tests during the course (PT), with a weight of 40% of the overall grade and a final exam (EF), with a weight of 40% of the overall grade, which will be held on the official date set for the exam.

The delivery of work or activities carried out during the course (T) will also be evaluated with a weight of 20%.

In the partial exams, isolated parts of the syllabus will be evaluated. In the final exam (FE) all the course material will be evaluated.

In the final exam a minimum grade of 4 out of 10 will be required to pass the course.

Therefore: $FG = 0,4 \cdot PT + 0,2 \cdot T + 0,4 \cdot FE$

* If the FG grade exceeds 5 points out of 10 but the FE grade is lower than 4 points, thefinal grade will be "suspense" with a numerical grade of 4,9.

B) Global Evaluation Mode.

Those students who choose the globa levaluation modality must officially obtain the waiver of the continuous evaluation modality, using the channels provided by the school, and will be evaluated within the official testing period (first and second opportunity) marked in the academic calendar of the course on the official dates set by the center. This global evaluation modality will take into account all the contents taught in the subject, both those taught in theory classes, problem sessionsand laboratory practices, and will represent 100% of the maximum grade.

In any case, in order to obtain a passing grade, the final grade must reach a minimum of 5 points out of 10.

Second chance exam.

Students who have not passed the course afterthe first opportunity, will be evaluated in the second opportunity of all the contents taught in the subject, both those taught in the theory classes, problem sessions and laboratory practices, and will represent 100% of the maximum grade.

EXTRAORDINARY SCHOOL-LEAVING EXAMS

The format of the exam may be different from the one detailed above. It will be carried out by means of a written exam in which the most relevant aspects of the subject will be addressed, both in theoretical issues and through numerical resolution problems that will allow to obtain 100% of the evaluation and a minimum of 50% must be reached to pass the subject.

It will not be allowed, in all tests, either considered continuous assessment or global assessment, the use of electronic devices such as tablet, smartphone, smartwatch, laptop, etc. or similar unauthorized devices.

Ethical commitment.

The student is expected to exhibit appropriate ethical behavior. If unethical behavior isdetected (copying, plagiarism, use of unauthorized electronic devices, etc.), the student will be considered ineligible to pass the course. In this case, the overall grade for the current academic year will be a failing grade (0.0).

The use of any electronic device will not be allowed during the evaluation tests, unless expressly authorized. The fact of introducing an unauthorized electronic device in the exam room will be considered a reason for not passing the subject in the current academic year and the overall grade will be a fail (0.0).

Sources of information

Basic Bibliography

Çengel Yunus A., Boles Michael A, **Thermodynamics: an engineering approach**, 7th ed, McGraw-Hil, 2011

Çengel, Yunus A., **Heat and mass transfer: a practical approach**, 4th ed, McGraw-Hill, 2011

Moran M.J.; Shapiro H.N., **Fundamentals of thermodynamics**, 8th ed. Wiley,

Incropera, F.P. et al, **Principles of heat and mass transfer**, 7th ed., international student version, Hoboken, N.J. : John Wiley,,

Complementary Bibliography

Heywood, J.B., **Internal combustion engines fundamentals**, McGraw-Hill,

Recommendations

Subjects that it is recommended to have taken before

Physics: Physics 1/V12G360V01102
Physics: Physics 2/V12G360V01202
Mathematics: Calculus 1/V12G360V01104
Mathematics: Calculus 2 and differential equations/V12G360V01204
Thermodynamics and heat transfer/V12G360V01405