



## IDENTIFYING DATA

### Thermodynamics and heat transfer

Subject	Thermodynamics and heat transfer			
Code	V09G290V01302			
Study programme	Degree in Energy Engineering			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	2nd	2nd
Teaching language	Spanish Galician			
Department				
Coordinator	Lopez Mera, David			
Lecturers	Lopez Mera, David			
E-mail	david.lopez.mera@uvigo.es			
Web	<a href="http://fatic.uvigo.es/">http://fatic.uvigo.es/</a>			
General description	Thermodynamics and transmission of heat.			

## Competencies

Code	
C10	Understanding and mastery of basic concepts of the general laws of mechanics and thermodynamics and how they can be applied to solve engineering problems. Heat and matter transfer and thermal machines.
D1	Capacity to interrelate all the acquired knowledge and interpret it as components in a body of knowledge with a clear structure and strong internal coherence
D2	Capacity to develop a complete project in any field included in this type of engineering, suitably combining acquired knowledge, accessing necessary information sources, undertaking the necessary enquiries and integrating into interdisciplinary work teams.
D3	Propose and develop practical solutions, which develop suitable strategies based on theoretical knowledge, for problem phenomena and situations that arise as everyday realities in engineering
D4	Encourage work based on cooperation, communication skills, organization, planning and recognition of responsibility in a multilingual and multidisciplinary working environment that fosters education in equality, peace and respect for fundamental rights
D7	Capacity to organise, interpret, assimilate, create and manage all the information needed to organise their work, handling the I.T., mathematical, physical and other tools required
D8	Conceive engineering within a framework of sustainable development with an awareness of environmental issues

## Learning outcomes

Expected results from this subject	Training and Learning Results	
Comprise the concept of *Exergía differentiated of the concept of Energy, and learn to calculate the *exergía available, the *exergía taken advantage of and the *exerxía stray in processes of thermodynamic systems	C10	D1 D2 D3 D4 D7
Comprise the thermodynamic basic appearances of the engines of alternative combustion and of the thermal head offices of gas, and learn to determine performances and energetic efficiencies and *exergéticas	C10	D1 D2 D3 D4 D7 D8

Comprise the thermodynamic basic appearances of the thermal head offices of steam, and learn to determine performances and energetic efficiencies and *exergéticas		D1 D2 D3 D4 D7 D8
Comprise the basic appearances of the machines *frigoríficas and bombs of heat, and learn to determine performances and energetic efficiencies and *exergéticas	C10	D1 D2 D3 D4 D7 D8
Comprise the physical bases of the transmission of heat by driving, and learn to determine flows of heat and distribution of temperatures mainly in means in solid phase		D1 D2 D3 D4 D7 D8
Comprise the physical bases of the transmission of heat by convection, and learn to determine flows of heat and distribution of temperatures in fluent means	C10	D1 D2 D3 D4 D7 D8
Comprise the physical bases of the transmission of heat by radiation, and learn to determine flows of heat and distribution of temperatures in solid and fluent means	C10	D1 D2 D3 D4 D7 D8

### Contents

Topic	
*EXERGÍA	*EXERGÍA
THERMODYNAMIC CYCLES	CYCLES ENGINES CYCLES REFRIGERATORS
THERMAL ENGINES	ENGINES OF COMBUSTION And EXPLOSION TURBINES OF STEAM And OF GAS
MACHINES *FRIGORÍFICAS And BOMBS OF HEAT	MACHINES *FRIGORÍFICAS And BOMBS OF HEAT
TRANSMISSION OF HEAT BY DRIVING	TRANSMISSION OF HEAT BY DRIVING. LAW OF FOURIER DRIVING *ESTACIONARIA ONE-DIMENSIONAL MULTIDIMENSIONAL DRIVING NO *ESTACIONARIA
TRANSMISSION OF HEAT BY RADIATION	THERMAL RADIATION SOLAR RADIATION
TRANSMISSION OF HEAT BY CONVECTION	FOUNDATIONS And CORRELATIONS OF THE CONVECTION. FLOWS *LAMINAR And TURBULENT
MIXES NO REACTIVE	MIXES NO REACTIVE

### Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	21	45	66
Problem solving	21	52.5	73.5
Studies excursion	3	0	3
Laboratory practical	5	0	5
Essay questions exam	2.5	0	2.5

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

### Methodologies

	Description
Lecturing	Exhibition by part of the professor of the contents of the matter *objecto of study. Bases in which *sustenta. Relation with other matters. Technological applications
Problem solving	Resolution of problems-example. Review of the problems that commands them do to the students along the course

Studies excursion	The realisation of the formative activity Exit of Studies, will be organised and made by the centre, taking like starting point the proposals made by the *profesorado of the matter on the type of installation/company to visit.
Laboratory practical	Experimentation of real processes in the laboratory that complement the contents of the matter.

### Personalized assistance

Methodologies	Description
Problem solving	All these activities will be *tuteladas by the professor; well during the hours *lectivas, well during the official hours of *tutorías, or during the review of the proofs and examinations For all the modalities of teaching, the sessions of *tutorización will be able to make by telematic means (email, videoconference, forums of *FAITIC, ...) Under the modality of *concertación previous.
Laboratory practical	All these activities will be *tuteladas by the professor; well during the hours *lectivas, well during the official hours of *tutorías, or during the review of the proofs and examinations. For all the modalities of teaching, the sessions of *tutorización will be able to make by telematic means (email, videoconference, forums of *FAITIC, ...) Under the modality of *concertación previous.

### Assessment

	Description	Qualification	Training and Learning Results
Lecturing	It values the attention of the student in the class and his *aprovechamiento continuous and progressive of the matter. *puntuan The answers of the students to the questions done by the professor as well as the interesting questions that do the students.  RESULTS OF LEARNING: Comprise the concept of *Exergía differentiated of the concept of Energy, and learn to calculate the *exergía available, the *exergía taken advantage of and the *exerxia stray in processes of thermodynamic systems. Comprise the thermodynamic basic appearances of the engines of alternative combustion and of the thermal head offices of gas, and learn to determine performances and energetic efficiencies and *exergéticas. Comprise the thermodynamic basic appearances of the thermal head offices of steam, and learn to determine performances and energetic efficiencies and *exergéticas. Comprise the basic appearances of the machines *frigoríficas and bombs of heat, and learn to determine performances and energetic efficiencies and *exergéticas. Comprise the physical bases of the transmission of heat by driving, and learn to determine flows of heat and distribution of temperatures mainly in means in solid phase. Comprise the physical bases of the transmission of heat by convection, and learn to determine flows of heat and distribution of temperatures in fluent means. Comprise the physical bases of the transmission of heat by radiation, and learn to determine flows of heat and distribution of temperatures in solid and fluent means.	15	C10 D1 D2 D3 D4 D7 D8
Problem solving	For those students that carry to the day the resolution of the problems and exercises that commission along the course. It values the capacity of the student to find solutions to said problems and exercises.  RESULTS OF LEARNING: Comprise the concept of *Exergía differentiated of the concept of Energy, and learn to calculate the *exergía available, the *exergía taken advantage of and the *exerxia stray in processes of thermodynamic systems. Comprise the thermodynamic basic appearances of the engines of alternative combustion and of the thermal head offices of gas, and learn to determine performances and energetic efficiencies and *exergéticas. Comprise the thermodynamic basic appearances of the thermal head offices of steam, and learn to determine performances and energetic efficiencies and *exergéticas. Comprise the basic appearances of the machines *frigoríficas and bombs of heat, and learn to determine performances and energetic efficiencies and *exergéticas. Comprise the physical bases of the transmission of heat by driving, and learn to determine flows of heat and distribution of temperatures mainly in means in solid phase. Comprise the physical bases of the transmission of heat by convection, and learn to determine flows of heat and distribution of temperatures in fluent means. Comprise the physical bases of the transmission of heat by radiation, and learn to determine flows of heat and distribution of temperatures in solid and fluent means.	15	C10 D1 D2 D3 D4 D7 D8

Laboratory practical	For those students that make 100% of the practices of laboratory. It values the implication of the student in the realisation of the practices and his capacity to apply the theoretical contents in the realisation of the experimental practices.	10	C10	D1 D2 D3 D4 D7 D8
	<p>RESULTS OF LEARNING:</p> <p>Comprise the concept of *Exergía differentiated of the concept of Energy, and learn to calculate the *exergía available, the *exergía taken advantage of and the *exerxia stray in processes of thermodynamic systems. Comprise the thermodynamic basic appearances of the engines of alternative combustion and of the thermal head offices of gas, and learn to determine performances and energetic efficiencies and *exergéticas. Comprise the thermodynamic basic appearances of the thermal head offices of steam, and learn to determine performances and energetic efficiencies and *exergéticas. Comprise the basic appearances of the machines *frigoríficas and bombs of heat, and learn to determine performances and energetic efficiencies and *exergéticas. Comprise the physical bases of the transmission of heat by driving, and learn to determine flows of heat and distribution of temperatures mainly in means in solid phase. Comprise the physical bases of the transmission of heat by convection, and learn to determine flows of heat and distribution of temperatures in fluent means. Comprise the physical bases of the transmission of heat by radiation, and learn to determine flows of heat and distribution of temperatures in solid and fluent means.</p>			
Essay questions exam	Examination written of questions of theory and of resolution of problems and/or exercises.	60	C10	D1 D2 D3 D4 D7 D8
	<p>RESULTS OF LEARNING:</p> <p>Comprise the concept of *Exergía differentiated of the concept of Energy, and learn to calculate the *exergía available, the *exergía taken advantage of and the *exerxia stray in processes of thermodynamic systems. Comprise the thermodynamic basic appearances of the engines of alternative combustion and of the thermal head offices of gas, and learn to determine performances and energetic efficiencies and *exergéticas. Comprise the thermodynamic basic appearances of the thermal head offices of steam, and learn to determine performances and energetic efficiencies and *exergéticas. Comprise the basic appearances of the machines *frigoríficas and bombs of heat, and learn to determine performances and energetic efficiencies and *exergéticas. Comprise the physical bases of the transmission of heat by driving, and learn to determine flows of heat and distribution of temperatures mainly in means in solid phase. Comprise the physical bases of the transmission of heat by convection, and learn to determine flows of heat and distribution of temperatures in fluent means. Comprise the physical bases of the transmission of heat by radiation, and learn to determine flows of heat and distribution of temperatures in solid and fluent means.</p>			

### Other comments on the Evaluation

Those students that make the tasks that commissions the professor along the course, and surpass the proofs of continuous evaluation, will be able to arrive to the final examination with an income of four points on ten, and will be able to reach with the resolution of the examination the maximum note of ten. Those students that do not make the tasks that commissions the professor along the course, and do not surpass the proofs of continuous evaluation, the maximum punctuation that will be able to obtain in the final examination is a six. Depending on the availability of time and programming of the course, will be able to do partial examinations of the matter. The examination of Julio will value on ten. Calendar of examinations. Verify/consult of up to date form in the web page of the centre: <http://minaseenerxia.uvigo.es/es/docencia/examenes>

### Sources of information

#### Basic Bibliography

Çengel, Yunus A., **Termodinámica**, 8ª edición, McGraw-Hill, 2015

Moran, M.J. y Shapiro, H. N., **Fundamentos de termodinámica técnica**, 2ª edición, Reverté, 2004

Çengel, Yunus A., **Transferencia de calor y masa: fundamentos y aplicaciones**, 4ª edición, MacGraw-Hill, 2011

Kreith, Frank, **Principios de transferencia de calor**, 7ª edición, Cengage Learning, 2012

#### Complementary Bibliography

### Recommendations

#### Subjects that continue the syllabus

Renewable energy installations/V09G290V01604

Thermal engines and turbo-machines/V09G290V01608

Applied heat transmission/V09G290V01606

Thermal energy management/V09G290V01706

Alternative fuels technology/V09G290V01703

Refrigeration and air conditioning technology/V09G290V01702

Generation and distribution of conventional and renewable thermal energy/V09G310V01533

### **Subjects that it is recommended to have taken before**

Physics: Thermal systems/V09G310V01302

Fluid mechanics/V09G310V01305

---

### **Other comments**

It does not recommend the registration in this matter while it do not have surpassed the matter Thermal Systems

---

### **Contingency plan**

---

#### **Description**

In front of the uncertain and unpredictable evolution of the sanitary alert caused by the \*COVID-19, the University establishes an extraordinary planning that will activate in the moment in that the administrations and the own institution determine it, attending to criteria of security, health and responsibility, and guaranteeing the teaching in a no face-to-face stage or no totally face-to-face. These already scheduled measures guarantee, in the moment that was prescriptive, the development of the teaching of a more agile and effective way when being known in advance (or with a wide \*antelación) by the students and the \*profesorado through the tool normalised and institutionalised of the educational guides \*DOCNET.

#### **1. Modality \*semipresencial**

In the case to activate the education \*semipresencial would suppose a reduction of the capacities of the educational spaces employees in the face-to-face modality, by what as first measure the centre would provide to the \*profesorado of the matter the relative information to the new capacities of the educational spaces, so as to that it can proceed to reorganise the formative activities of the that subtracts of the \*cuatrimestre. It fits to signal that the reorganisation will depend of the moment along the \*cuatrimestre in that it activate said modality of education. In the reorganisation of the educations would follow the following guidelines:

Inform to all the students through the platform \*FaiTIC of the conditions in that they will develop the formative activities and the proofs of evaluation that subtract to finalise the \*cuatrimestre.

The sessions of \*tutorización will be able to make by telematic means (email, videoconference, forums of \*FAITIC, ...) Under the modality of \*concertación previous.

In case that part of the students have made practical of instrumental laboratory or of computing of face-to-face form, make \*presencialmente, possibly, these activities or equivalent for the students that did not make them.

Of the activities that subtract to finalise the \*cuatrimestre, identify those formative activities that can be made by all the students of face-to-face form and the formative activities that will make in remote way.

In relation the tools to employ in the formative activities that make in way no face-to-face, will have the use of \*CampusRemoto and the platform \*FaiTIC.

#### **2. Modality no face-to-face**

In the case in that it activate the modality of education no face-to-face (suspension of all the formative activities and of face-to-face evaluation) will employ the available tools in the actuality in the University of Vigo: Remote Campus and \*FaiTIC. The conditions of reorganisation will depend of the moment along the \*cuatrimestre in that it activate said modality of education. In the reorganisation of the educations would follow the following guidelines:

##### **2.1. Communication**

Inform to all the students through the platform \*FaiTIC of the conditions in which will give back the formative activities and the proofs of evaluation that subtract to finalise the \*cuatrimestre.

##### **2.2. Adaptation and/or modification of educational methodologies**

Since the educational methodologies are conceived for the modality of face-to-face education indicate to continuation the educational methodologies that \*mantendrían and \*cuales would modify or would substitute in the no face-to-face modality. The educational methodologies that keep are the following, since they can employ in face-to-face modality and no face-to-face

Lesson \*magistral

The educational methodologies that modify are the following

Practical of instrumental laboratory.

2.3. Adaptation of attention of \*tutorías and attention customised

The sessions of \*tutorización will be able to make by telematic means (email, videoconference, forums of \*FAITIC, ...) Under the modality of \*concertación previous.

2.4. Evaluation

If they have to delete the practices of laboratory the weight of which do not find made will happen to form part of the final examination.

2.5. Bibliography or additional material to facilitate to car-learning  
will not be necessary bibliography or additional material

---