COURSE DATA

DATA SUBJECT

Code: 34923
Name: Applied thermodynamics and heat transfer
Cycle: Undergraduate Studies
ECTS Credits: 6
Academic year: 2026-27

STUDY (S)

Degree	Center	Acad. year	Period
1404 - Degree in Industrial Electronic Engineering	Escola Tècnica Superior d'Enginyeria	2	Second quarter

SUBJECT-MATTER

Degree	Subject-matter	Character
1404 - Degree in Industrial Electronic Engineering	Applied thermodynamics and heat transfer	COMPULSORY

COORDINATION

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SUMMARY

The course ***Applied Thermodynamics and Heat Transfer*** is a compulsory course taught in the second year of the degree in Industrial Electronic Engineering in the second (spring) semester. In the curriculum of the University of Valencia has a total of 6 ECTS.

Thermodynamics is a fundamental science that studies the energy, and, since a long time, it is an essential worldwide part of engineering curricula. The purpose of this subject is to provide students with an introductory treatment of Thermodynamics from the engineering point of view. This science has a universal applicability, as evidence by the fact of being used in different areas such as Physics, Chemistry and Engineering; in fact, the thermodynamic principles are the same, but their applications differ. The basic applications from the engineering point of view are determination of the needs of heat and work in the physical and chemical processes, distinguishing two major application areas, power generation and refrigeration.

This subject aims to provide students the ability to design and manage the operation of thermal systems of industrial plants. For this purpose, in this subject is studied the basic knowledge of estimated properties of

pure substances, it is treated the actual processes of typical energy transformation of the industry (heat generation process, air conditioning, gas, steam and refrigeration power cycles, among others), and finally, it is analyzed the physical fundamentals of the different forms of heat transfer.

The contents of the subject are**: Basics of applied thermodynamics. Heat transfer mechanisms. Basic principles of thermotechnology. Furnaces and boilers. Heat engines. Refrigeration circuits and systems.**

The theory classes will be taught in Spanish and practical classes as stated in the course information available on the website of the degree.

PREVIOUS KNOWLEDGE

RELATIONSHIP TO OTHER SUBJECTS OF THE SAME DEGREE

There are no specified enrollment restrictions with other subjects of the curriculum.

OTHER REQUIREMENTS

The background needed for this subject is basic knowledge of physics, mathematics and chemistry, as well as basic level of English reading.

COMPETENCES / LEARNING OUTCOMES

1404 - Degree in Industrial Electronic Engineering

CG11 - Knowledge, understanding and ability to apply the necessary legislation for practising professionally as a qualified industrial engineer.

CG18 - Knowledge of applied thermodynamics and heat transfer. Basic principles and their application to solve engineering problems.

CG3 - Knowledge of basic and technological subjects that allows students to learn new methods and theories and provides them with versatility to adapt to new situations.

CG4 - Ability to solve problems with initiative, decision-making skills, creativity and critical reasoning and to communicate and transmit knowledge, abilities and skills in the field of industrial engineering (with specific industrial electronics technology).

CG6 - Ability to deal with specifications, regulations and mandatory standards.

CG9 - Ability to organise and plan work in companies and in other institutions and organisations.

DESCRIPTION OF CONTENTS

1. INTRODUCTION

Thermodynamic state and its surroundings. Internal energy. The first law of thermodynamics. State function. Enthalpy. The steady-state steady-flow process. The reversible process. The second law of thermodynamics. Entropy. Heat engines.

2. VOLUMETRIC BEHAVIOUR (or PVT) OF PURE SUBSTANCES

PVT diagrams and properties tables. Equations of state. Generalized correlations for gases and liquids.

3. THERMODYNAMICS OF STEAM

Liquid and vapour saturated. Superheated steam. Thermodynamic diagrams. Thermodynamic tables.

4. COMBUSTION

Fuels. Energy and mass balances in the combustion process. Adiabatic flame temperature.

5. VAPOR POWER CYCLES

Thermal power plant performance. Carnot cycle. Rankine cycle. Cogeneration systems.

6. GAS POWER CYCLES

Internal combustion engines. Otto cycle. Diesel cycle. Gas turbines. Brayton cycle. Other power cycles.

7. REFRIGERATION CYCLES

Vapor-compression refrigeration systems. Class of refrigerants. Cascade vapor-compression refrigeration systems. Gas refrigeration systems. Reversed Brayton cycle. Absorption refrigeration. Circuits and industrial refrigeration systems.

8. HEAT TRANSFER BY CONDUCTION AND CONVECTION

Heat transfer mechanism. Rate equation in molecular heat transport: Fourier's law. Heat conduction in solids. Heat conduction through composite walls. Rate equation in turbulent flow: individual coefficient. Heat flow between phases: overall heat transfer coefficient.

9. RADIATION

Fundamental equation of radiation. Radiation Exchange between surfaces. Individual heat transfer coefficient by radiation. Radiation in the presence of other mechanisms of heat transfer. Furnaces and boilers.

WORKLOAD

PRESENCIAL ACTIVITIES

Activity	Hours
Theory	35,00
Classroom practices	25,00
Total hours	**60,00**

NON PRESENCIAL ACTIVITIES

Activity	Hours
Attendance at other activities	0,00
Individual or group project	20,00
Independent study and work	0,00
Preparation of lessons	45,00
Preparation for assessment activities	25,00
Resolution of case studies	0,00
Total hours	**90,00**

TEACHING METHODOLOGY

The development of the course is structured in lectures on the theory together with the resolution of related problems, and carrying out works.

In the lectures, master classes will be the basic methodology. The professor will present by means of presentation and/or explanation of the contents highlighting those key aspects for understands them. The main competences worked on by these activities will be CG3, CG4, CG6, CG9, CG11, y CG18.

Practical sessions of problems will be developed following two models. Some of the classes will be the professor who solves a series of sample problems in order to help the students to identify the essential

elements of the way the problem is set out and its solution. In other practical sessions will be the students, individually or in team, who should solve similar problems under the supervision of the professor. After the work, the problems will be collected, analyzed and corrected by the professor. The main competences worked on by these activities will be CG3, CG4, CG6, CG9, CG11, y CG18.

The proposed work to the student will be divided into two types: complete Problems, with a similar complexity to the problem exams, and Tests, designed to prepare the most important concepts of each

unit. At the end of the lectures, a test will be made, and the problems will have a timetable for its completion and delivery by the students. After its correction, the students will be informed of their results. The main competences worked with these activities will be CG3, CG4, CG6, CG9, CG11, y CG18.

EVALUATION

The evaluation of student learning is based on continuous evaluation, in which the activities carried out by the students (questionnaires and problems submitted) and the examination carried out on the official date will be assessed.

The final grade will be obtained as the highest of:

- the weighting between the average grade of the questionnaires (20%), problems submitted (15%) and examination (65%), or
- grade for the examination plus 5% of the weighted average grade for the activities (questionnaires and problems submitted)

If the grade of the examination is less than 4 (out of 10), the final grade will be the grade of the examination.

The grade of *Not Presented* will be obtained only when the student does not take examination on the official date, even if he or she has partially or completely done the proposed continuous evaluation activities (questionnaires and problems submitted).

The examination will consist of theoretical-practical questions and problems.

The subject will be considered passed when the grade obtained is equal to or greater than 5 (out of 10).

In any case, the evaluation system will be governed by that established in the Evaluation and Qualification Regulations of the University of Valencia for Bachelor's and Master's Degrees (ACGUV 108/2017).

Copying or plagiarism of any activity that is part of the evaluation will result in the impossibility of passing the course, and the student will then be subject to the appropriate disciplinary procedures indicated in the ACTION PROTOCOL FOR FRAUDULENT PRACTICES AT THE UNIVERSITY OF VALENCIA (ACGUV 123/2020).

REFERENCES

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- MORAN, Michael J. y SHAPIRO, Howard N., 2004, Fundamentos de Termodinámica Técnica, 2ª ed (4ª original), Reverté, Barcelona.

- SANCHOTELLO, Margarita y ORCHILLÉS, Antoni V., 2007, Transmissió de calor, 1ª ed., PUV, Valencia

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- DE LUCAS, Antonio, 2004, Termotecnia Básica para Ingenieros Químicos: Bases de Termodinámica Aplicada, Universidad de Castilla-La Mancha.

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- YAWS, Carl L., 2014, Thermophysical Properties of Chemicals and Hydrocarbons (Second Edition), Elsevier Science, Amsterdam. (http://www.sciencedirect. com/science/book/9780323286596)