COURSE DATA

DATA SUBJECT

Code: 34752
Name: Applied thermodynamics and heat transfer
Cycle: Undergraduate Studies
ECTS Credits: 6
Academic year: 2025-26

STUDY (S)

Degree	Center	Acad. year	Period
1401 - Degree in Chemical Engineering	Escola Tècnica Superior d'Enginyeria	2	Second quarter
1934 - Double Degree Program in Chemistry-Chemical Engineering	Facultat de Química	2	Second quarter

SUBJECT-MATTER

Degree	Subject-matter	Character
1401 - Degree in Chemical Engineering	Applied thermodynamics and heat transfer	COMPULSORY
1934 - Double Degree Program in Chemistry-Chemical Engineering	Segundo curso	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 Chemical Engineering in the second (spring) semester. In the curriculum of the University of Valencia has a total of 6 ECTS.

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

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.**

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

COMPETENCES / LEARNING OUTCOMES

1401 - Degree in Chemical Engineering

Ability to handle specifications, regulations and standards of compliance.

Acquire knowledge of basic and technological subjects to facilitate the learning of new methods and theories, and develop the versatility to adapt to new situations.

Act autonomously in learning, make informed decisions in different contexts, issue judgements based on experimentation and analysis and transfer knowledge to new situations.

Apply knowledge of applied thermodynamics and heat transfer to solve engineering problems.

Be able to understand and apply the legislation required for the practice of the profession of technical industrial engineer.

Propose creative and innovative solutions to complex situations or problems, typical of the area of ¿¿¿¿connection, to donate responses to the various professional and social needs

Solve problems with initiative, make decisions, think creatively and critically, and communicate and convey knowledge, skills and competences in the field of industrial engineering.

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 SUSBSTANCES

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.

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.

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 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. Part of these activities will be made during the lectures, and the rest of them will be optional deliveries for a proper preparation of the course by the students. After its correction, the students will be informed of their results and a summary of the most consolidated and frequent failures.

EVALUATION

The assessment of student learning will be carried out using two models:

Model A: The assessment with this model is based on a continuous assessment taking account the works (tests and proposed problems) and two partial objective exams according to two parts (Part I: units 1 to 4 and Part II: units 5 to 9). The partial exam of Part I will be when these contents finish, and the partial exam of Part II will be on the official date for first vocation.

The final mark will be calculated as the greater one of:

- the weighting between the average mark of the tests (20%), delivered problems (15%) and the grade of the two partial objective exams (65%),or
- the grade of the two partial objective exams plus a 5% of the average mark of the works (tests and proposed problems)

If a minimum mark of 4 (out of 10) is not gotten in the average score of the tests, the final mark will be the average of the two partial objectives tests.

Model B: The assessment of the course with this model will be realized through an exam of all contents of the course in the official date. The activities carried out throughout the course will also be valued, although they have a lower percentage weight in the final grade than in Model A.

The final mark with this model will be obtained as the greater one of:

- the weighting between the average mark of activities (20%) and the mark of the exam (80%), or
- the mark of the exam

If a minimum mark of 4 (out of 10) is not gotten in the exam, the final mark will be the grade obtained in the exam.

In the first call, the student will accept one of the two evaluation models, in such a way that if the student presents himself/herself to the first partial objective test, he/she will be evaluated according to Model A. The student will not be able to renounce the A modality of evaluation after taking the partial exam.

On the second call the evaluation will be conducted by Model B.

The qualification of *Not presented* will be obtained only when the student does not take any of the partial objective tests (in Model A) or the final exam (in Model B), even if he/she has partially or completely carried out the proposed continuous evaluation activities (questionnaires and deliverable problems).

The exams will have theoretical and practical questions and problems.

The subject will be passed when the average final mark is equal or greater than 5 (out of 10).

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).

Anyhow, the evaluation system will be based on the guides stated in the "Reglament d'Avaluació i Qualificació de la Universitat de València per a Graus i Màsters" (ACGUV 108/2017).

REFERENCES

- SMITH, Joe M., VAN NESS, Hendrick C. y ABBOTT, Michael M., 2014, Introducción a la Termodinámica en ingeniería Química (octava edición). McGraw-Hill Interamericana (https: //links.uv.es/gUKvi8e)

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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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- POLING, Bruce E., PRAUSNITZ, John M., O'CONNELL, John P., 2001, The properties of gases and liquids. McGraw-Hill, New York.

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