Universidad del País Vasco Euskal Herriko Unibertsitatea

COURSE GUIDE 2025/26

Faculty 363 - Faculty of Engineering - Bilbao **Cycle** .

Degree GMECAN30 - Bachelor`s Degree in Mechanical Engineering **Year** Second year

COURSE

26609 - Thermal Engineering **Credits, ECTS:** 6

COURSE DESCRIPTION

Thermal Engineering is a compulsory subject in the study plan for obtaining the degrees in Electrical Engineering, Mechanical Engineering and Industrial Electronics and Automation Engineering. It is taught, in a grouped way for the three degrees, during the first semester of the second year.

It is a subject that covers the basic principles of thermodynamics and general transmission of heat and its application to engineering problems.

Before approaching the study of the subject Thermal Engineering, it is recommended to have taken the course of Physical Fundamentals of Engineering and have an adequate basis in calculus and algebra. However, the concepts of fluid mechanics and differential equations are presented and revised along the course, when needed.

Thermal Engineering constitutes the basis of the course Thermal Installations and Machines (Degree in Mechanical Engineering) and is linked to Fluid Mechanics, as mass, energy and entropy balances; properties of pure substances and fundamental mechanisms of heat transfer are competences of this subject.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

The skills developed by the subject are, for each of the three specialties in which it is taught:

* Knowledge of basic and technological subjects, which enables them to learn new methods and theories, and gives them the versatility to adapt to new situations.
* Ability to solve problems with initiative, decision-making, creativity, critical reasoning and to communicate and transmit knowledge, skills and abilities in the field of Industrial Engineering.
* Apply the strategies of scientific methodology: analyze the situation and problems qualitatively and quantitatively. Propose hypotheses and solutions using the models of industrial engineering.
* Work effectively in a group integrating skills and knowledge to make decisions in the field of industrial engineering.

More specifically, the skills developed in this subject are:

- Reasonably apply the energy balances in the main equipment that forms part of the thermal installations.
- Analyze thermal equipment and installations with the tools derived from the Second Principle and interpret the results in terms of energy savings and efficiency.
- Identify and analyze the modes of heat transmission and reflect on the possible means of increasing or reducing the rate of heat transmission.
- Handle various forms of representation with ease, such as graphs, tables, diagrams or formulations, both to extract information and to use them when expressing results.

Theoretical and Practical Contents

Basic concepts of thermodynamics.
- Review of thermodynamic concepts studied in previous subjects.

First principle of thermodynamics.
- Energy balance in closed systems.
- Mass and energy balances in open systems.
- Application to devices in steady-state regime.

Second principle of thermodynamics.
- Kelvin-Planck and Clausius statements.
- Entropy. Principle of Increasing the Entropy of the Universe.
- Entropy balance.
- Application to devices in steady-state regime.
- Application to cyclic processes of interest.

Basic concepts of heat transfer.
- Thermodynamics and heat transfer.
- Heat transfer in engineering.
- Conduction.

- Convection.
- Radiation.
- Simultaneous heat transfer mechanisms.

TEACHING METHODS

THEORY (M) AND CLASSROOM PRACTICAL SESSIONS (GA)

During the lectures (M), the theoretical content of each topic is explained to the students, raising different questions about the treated chapter. To help assimilate the theoretical content, in the classroom practices (GA) several exercises are proposed that can be solved by the teacher or a student.

Each chapter will have a related PowerPoint and a PDF document with a series of exercises to be performed during the GA and other exercises with solutions to be solved by the student. Both documents will be on the eGela platform.

LABORATORY PRACTICES (GL)

The laboratory practices (GL) will be developed during several sessions throughout the course. The corresponding scripts will be available on the eGela platform.

Each student will do a TEST before going to the laboratory and perform data collection. These tests will be instantaneously marked by means of the eGela platform. Finally, a report by groups (usually 4 students per group), must be delivered within 1 week, with the results and conclusions of the practice.

COMPUTER PRACTICES (GO)

The third type of task to be developed by the students consists of solving problems using the EES software in the Computer Practices (GO) that will be developed throughout the course. The statements of each practice session will be available in eGela. At the end of the sessions, each student must solve and submit a problem, individually, for grading.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	30		15	6	9				
Horas de Actividad No Presencial del Alumno/a	45		22,5	9	13,5				

Legend:
M: Lecture-based | S: Seminar | GA: Applied classroom-based groups
GL: Applied laboratory-based groups | GO: Applied computer-based groups | GCL: Applied clinical-based groups
TA: Workshop | TI: Industrial workshop | GCA: Applied fieldwork groups

Evaluation methods

- Continuous evaluation
- End-of-course evaluation

Evaluation tools and percentages of final mark

- Written test, open questions 70%
- Exercises, cases or problem sets 20%
- Teamwork assignments (problem solving, Project design) 10%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

The WRITTEN TEST will be composed of problems and theoretical questions and will account for 70% of the final grade. To pass the course it will be necessary to obtain at least 40% in the written test. If the minimum required is not reached, the written test note will appear in the minutes.

FINAL SCORE: WRITTEN TEST (70%) + LABORATORY PRACTICES (10%) + COMPUTER PRACTICES (EES) (20%)

The practices (computer and laboratory) will be evaluated during the semester, according to the attendance and the correct execution of the activities that are proposed. It will account for 30% of the final grade.

Students who have not attended the practice sessions, or who have failed them, may take, on the same day as the written exam, an additional test where the competencies corresponding to this part of the subject will be assessed.

- To give up the ordinary evaluation, it will be enough to not attend the written exam

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

The extraordinary call will be performed through a final evaluation system and will consist of the following tests:

- A WRITTEN TEST composed of problems and theoretical questions. This part will account for 70% of the final grade and to pass the course it will be necessary to obtain at least 40% in it. If the minimum required is not reached, the written test note will appear in the minutes.

- An additional test for the evaluation of the practices (computer and laboratory). This part will account for 30% of the final grade and the positive results obtained by the students during the course may be kept.

FINAL SCORE: WRITTEN TEST (70%) + LABORATORY PRACTICES (10%) + COMPUTER PRACTICES (EES) (20%)

- To give up the ordinary evaluation, it will be enough to not attend the written exam.

MANDATORY MATERIALS

- Materials that will be published throughout the course on the eGela virtual platform (power point presentations, problem statements, thermodynamic tables and diagrams, practice scripts, exercises, reports, etc.).

- Use of the "Engineering Equation Solver" (EES) program.

BIBLIOGRAPHY

Basic bibliography

Çengel, Y.A., Boles, M.A. "Termodinámica". Ed. McGraw-Hill
Çengel, Y.A. "Transferencia de calor". Ed. McGraw-Hill
Incropera, F.P., De Witt, D.P. "Fundamentos de transferencia de calor". Ed. Prentice Hall
Moran, M.J., Shapiro, H.N. "Fundamentos de termodinámica". Ed. Reverté

Detailed bibliography

Baehr, H.D. "Tratado moderno de termodinámica". Ed. Montesó
Chapman, A.L. "Fundamentals of heat transfer". Ed. Macmillan
Kreith F., Bohn M.S. "Principios de transferencia de calor". Ed. Thomson
Van Wylen, G.J., "Fundamentos de termodinamica". Ed. Limusa Wiley

Journals

Applied Thermal Engineering
Energy
International Journal of Energy Research
International Journal of Heat and Mass Transfer
International Journal of Refrigeration

Web sites of interest

Agencia Internacional de Energía: www.energuia.com
Energuia: www.iea.org
ManagEnergy: www.managenergy.net
ScienceDirect: www.sciencedirect.com

OBSERVATIONS

FINAL EVALUATION SYSTEM:

This system, recognized and regulated in Article 8 of the Student Assessment Regulations, establishes that students will have the right to be assessed through the final evaluation system, regardless of whether or not they have participated in the continuous evaluation system.

To do this, students must submit to the teaching staff responsible for the subject the waiver of continuous assessment, for which they will have a period of 9 weeks, from the beginning of the semester, in accordance with the academic calendar of the center.