1. DATOS BÁSICOS

Asignatura	Thermodynamics and Fluid Mechanics
Titulación	Degree in Industrial Organization Engineering
Escuela/ Facultad	School of Science, Engineering and Design
Curso	Third
ECTS	6 CTS
Carácter	Mandatory
Idioma/s	English
Modalidad	Presential
Semestre	Sixth semester
Curso académico	2024/2025
Docente coordinador	Enrique Bayonne Sopo
Docente	Enrique Bayonne Sopo

2. PRESENTATION

Thermodynamics and Fluid Mechanics is taught in the third year (second semester) of the Degree in Industrial Organization. It is a subject with two differentiated parts, since on the one hand it includes knowledge related to Thermodynamics, and on the other hand it includes knowledge of Fluid Mechanics. Thermodynamics comes from the Greek "Thermodynamics" which means the study of the forces that originate heat, it describes the efforts to convert heat into power. It has its origins in the middle of the 18th century as a consequence of the need to describe and optimize the operation of steam engines, so that current thermodynamics is the result of more than 250 years of theoretical and experimental foundation. Thermodynamics today encompasses not only the study of heat but of all forms of energy and its transformations, which is why it is known as "the Science of Energy". Classical thermodynamics, which is the one addressed in this basic course, deals with equilibrium states and not with dynamic systems, so Thermodynamics could be defined as: the field of physics that describes and relates the physical properties of macroscopic systems (set of matter that can be spatially isolated and that coexists with an infinite and unperturbed environment) of matter and energy.

The section about "Fluid Mechanics" aims to acquire the knowledge of the fundamental principles of fluid mechanics and its application to solving problems in the field of engineering. These processes are present almost permanently in most industries through hydraulic, oil-hydraulic, compressed gas, heat transmission or energy production installations, among others. The basic theoretical concepts that allow understanding the properties of fluids and describing the kinematic and dynamic properties of the fluid field through the application of the fundamental equations based on the principles of conservation of mass, quantity of motion and energy are introduced.

3. LEARNING OUTCOMES

Skills

SK10 - Use knowledge of the basic principles of applied thermodynamics and heat transfer to solve problems in engineering projects and operations..
SK11 - Use knowledge of the basic principles of fluid mechanics, including the calculation of pipes, channels and fluid systems, to solve problems in engineering projects and operations..

- Effectively solve basic problems related to fluid dynamics and fluid mechanics that engineering projects involve, be it open and closed cycles, heat transfer systems, or piping dimensioning..

Upon passing the subject, the student will be able to effectively solve basic problems related to thermodynamics and fluid mechanics that engineering projects include, whether they are open and closed cycles, heat transfer systems, or dimensioning of conductions.

Competences
CPT01 - Create new ideas and concepts from known ideas and concepts, reaching conclusions or solving problems, challenges and situations in an original way in the academic and professional environment.
CPT02 - Transmit messages (ideas, concepts, feelings, arguments), both orally and in writing, strategically aligning the interests of the different agents involved in communication in the academic and professional environment.
CPT05 - Cooperate with others in the pursuit of a shared academic or professional goal, participating actively, empathetically and with active listening and respect for all members.
CPT06 - Integrate analysis with critical thinking in a process of evaluating different professional ideas or possibilities and their potential for error, based on objective evidence and data leading to effective and valid decision making.

4. CONTENT

The subject is organized into four learning units, which in turn are divided into topics (the number of topics depends on the particular unit):

Unit 1. Principles of Thermodynamics

Unit 2. Gases and fluids in phase change

Unit 3. Power cycles with gas or steam

Unit 4. Heat transfer processes

Unit 5. Principles of fluid mechanics

Unit 6. External and confined flows. Piping calculation

5. TEACHING-LEARNING METHODOLOGIES

The types of teaching-learning methodologies used are indicated below:

- Lecture
- Cooperative learning
- Problem Based Learning (PBL)
- Project-based learning
- Learning based on laboratory teachings (laboratory practices, workshop practices, simulation environments).
- Case method
- Gamification

- Field experience

Listed below are the types of learning activities and the number of hours the student will spend on each one:

Learning activity	Number of hours
Lectures and practical seminars	31
Problem solving	10
Case studies	9
Virtual laboratory practices and simulations	14
Virtual forum (discussion and colloquium)	8
Learning contract (definition of interests, needs and objectives)	2
Study of content and supplementary documentation (autonomous work)	62
Virtual tutorials	12
Knowledge tests	2
TOTAL	**150**

6. ASSESSMENT

Listed below are the assessment systems used and the weight each one carries towards the final course grade:

Sistema de evaluación	Peso
Presential tests to evaluate theoretical/practical content objectives	50%
Non-attendance tests to evaluate theoretical/practical content objectives	30%
Tests to evaluate attitudes	10%
Self- and co-evaluation tests	10%

When you access the course on the *Campus Virtual*, you'll find a description of the assessment activities you have to complete, as well as the delivery deadline and assessment procedure for each one.

7.1. First exam period

In order to pass the course in the ordinary exam, you must obtain a grade higher or equal to 5.0 out of 10.0 in the final grade (weighted average) of the course.

In any case, it will be necessary to obtain a grade higher or equal to 4.0 in the final exam, so that it can be averaged with the rest of the evaluable activities.

In the case of the face-to-face degree, there will be a partial test at the end of unit 3 (coinciding with the end of the thermodynamics course). A grade higher or equal to 5.0 in this partial exam will allow the students to take the exam in the ordinary exam only of the remaining units. The mark for the ordinary exam will be the average of the marks of both mid-term exams, maintaining the conditions described in the preceding paragraphs for a pass. If the student does not pass, the whole syllabus will be examined in the extraordinary exam session.

When the teacher identifies a student copying or suspects that he/she has done so in an evaluable test or activity (e.g. copying from other classmates or from IA tools); if the student cannot prove otherwise or that he/she possesses the knowledge and competences associated with the test or activity, this will be evaluated with a grade of 0. Higher sanctions may be considered in accordance with the University's General Coexistence Regulations.

Attendance:
The minimum attendance requirement to be able to sit the final knowledge test in the Ordinary Examination is 50%; this may be increased, at the professor's discretion, depending on the nature of the subject and the activity. Cases that do not meet this requirement, unless justified with evidence approved by the University, will only be able to access the Extraordinary Examination.

Virtual attendance (hyflex) to the sessions is only allowed for justified cases approved by the University, otherwise it will be registered as non-attendance.

The lecturer will keep track of student attendance through the virtual campus attendance system. The professor will establish as 'Late Attendance' those cases in which the student arrives late or leaves the classroom before the end of the session..

Processes:
Communications related to the subject will be carried out exclusively through the virtual campus or by e-mail (in the case of the lecturer, the corporate one).

Communications related to the degree or University, on the part of the student, will be carried out exclusively through the Student Portal and will be dealt with by Academic Advising.

Coexistence:
After a student has been reprimanded three consecutive times for behaviour that is not conducive to a favourable learning environment in class or involves a lack of respect for the teacher or other classmates, he/she will be invited to leave the classroom in order to preserve an appropriate learning environment. Depending on the offence, higher sanctions may be considered in accordance with the University's General Coexistence Regulations.

The lecturer will inform the Degree Coordination Office about students who have compromised the rules of coexistence, copied or potentially copied in a knowledge test or assessable activity

Use of IA regulation
The student must be the author of his/her work/activities.
The use of Artificial Intelligence tools (AI) must be authorized by the teacher in each assignment/activity, indicating in what way it uses is permitted. The teacher will inform in advance in which situations AI tools

may be used to improve spelling, grammar and editing in general. The student is responsible for clarifying the information given by the tool and duly declaring the use of any AI tool, according to the guidelines given by the teacher. The final decision on the authorship of the work and the appropriateness of the reported use of an AI tool rests with the lecturer and those responsible for the degree.

Plagiarism regulation
In accordance with the current student disciplinary regulations at Universidad Europea:

- Plagiarism, in full or in part, of intellectual works of any kind, is considered a very serious offense.
- Very serious offenses relating to plagiarism and the use of fraudulent means to pass assessment tests shall result in exclusion from the exams for the relevant period, as well as the inclusion of the offense and its details in the student's academic record. For more information you can find all information regarding disciplinary regulations at the following link:

7.2. Second exam period

In order to pass the course in the extraordinary exam, you must obtain a grade higher or equal to 5.0 out of 10.0 in the final grade (weighted average) of the course.

In any case, it will be necessary to obtain a grade higher or equal to 4.0 in the final test, so that it can be averaged with the rest of the activities.

The activities that were not passed in the ordinary exam must be handed in, after having received the corresponding corrections from the teacher, or those that were not handed in.

7. SCHEDULE

This table shows the delivery deadline for each assessable activity in the course:

Actividades evaluables	Fecha
Activities Unit 1	Week 4 – 24/03/25
Activities Unit 2	Week 7 – 17/03/25
Activities Unit 3	Week 10 – 07/04/25
Partial Examination 1	Week 14– 02/05/25
Activities Unit 4	Week 15 – 05/05/25
Laboratory Practical Repor	Week 17 – 19/05/25
Activities Unit 5	Week 18 – 26/05/25
First exam period	Official announcement. June 2025

This schedule may be subject to changes for logistical reasons relating to the activities. The student will be notified of any change as and when appropriate.

8. BIBLIOGRAPHY

The reference work for following the subject in the Thermodynamics part is:

- Class material, provided by the teacher.
- Moran, M. J., & Shapiro, H. N. (2010). Fundamentals of Engineering Thermodynamics (7th ed.). Wiley.
- Boyce, M. P. (2011). Gas Turbine Engineering Handbook (4th ed.). Butterworth-Heinemann.
- Cengel, Y. A., & Boles, M. A. (2014). Thermodynamics: An Engineering Approach (8th ed.). McGraw-Hill Education.
- Callen, H. B. (1985). Thermodynamics and an Introduction to Thermostatistics (2nd ed.). Wiley.
- Van Wylen, G. J., Sonntag, R. E., & Borgnakke, C. (2002). Fundamentals of Classical Thermodynamics (5th ed.). Wiley.
- Bejan, A. (1997). Advanced Engineering Thermodynamics (2nd ed.). Wiley.
- IUPAC. (1997). Compendium of Chemical Terminology (2nd ed.). Blackwell Scientific Publications.
- Kittel, C., & Kroemer, H. (1980). Thermal Physics (2nd ed.). W. H. Freeman.
- Reif, F. (1965). Fundamentals of Statistical and Thermal Physics. McGraw-Hill.

The reference work for the Fluid-Mechanics part of the course is:

- Moran, Moran, M. J., & Shapiro, H. N. (2011). *Fundamentals of Engineering Thermodynamics*. John Wiley & Sons.
- White, F. M. (2003). *Fluid Mechanics*. McGraw-Hill.
- Çengel, Y. A., & Cimbala, J. M. (2014). *Fluid Mechanics: Fundamentals and Applications*. McGraw-Hill Education.
- Munson, B. R., Young, D. F., Okiishi, T. H., & Huebsch, W. W. (2009). *Fundamentals of Fluid Mechanics*. John Wiley & Sons.
- Batchelor, G. K. (2000). *An Introduction to Fluid Dynamics*. Cambridge University Press.
- Fox, R. W., McDonald, A. T., & Pritchard, P. J. (2015). *Introduction to Fluid Mechanics*. John Wiley & Sons.
- Kundu, P. K., Cohen, I. M., & Dowling, D. R. (2015). *Fluid Mechanics*. Academic Press.
- Panton, R. L. (2013). *Incompressible Flow*. John Wiley & Sons.
- Streeter, V. L., Wylie, E. B., & Bedford, K. W. (1998). *Fluid Mechanics*. McGraw-Hill.
- Schlichting, H., & Gersten, K. (2017). *Boundary-Layer Theory*. Springer.

9. UNIDAD DE ORIENTACIÓN EDUCATIVA Y DIVERSIDAD

From the Educational Guidance and Diversity Unit (ODI) we offer support to our students throughout their university life to help them achieve their academic achievements. Other pillars of our action are the

inclusion of students with specific educational support needs, universal accessibility on the different campuses of the university and equal opportunities.

This unit offers students:

1. Accompaniment and follow-up by means of counselling and personalised plans for students who need to improve their academic performance.
2. 2. In terms of attention to diversity, non-significant curricular adjustments are made, i.e. in terms of methodology and assessment, for those students with specific educational support needs, thereby pursuing equal opportunities for all students.
3. 3. We offer students different extracurricular training resources to develop different competences that will enrich their personal and professional development.
4. 4. Vocational guidance through the provision of tools and advice to students with vocational doubts or who believe they have made a mistake in their choice of degree.

Students in need of educational support can write to us at:
orientacioneducativa.uev@universidadeuropea.es

10. ONLINE SURVEYS

Your opinion matters!

The Universidad Europea encourages you to participate in several surveys which help identify the strengths and areas we need to improve regarding professors, degree programs and the teaching-learning process.

The surveys will be made available in the “surveys” section in virtual campus or via e-mail.

Your assessment is necessary for us to improve.

Thank you very much for your participation.

WORK PLAN FOR THE COURSE

HOW TO COMMUNICATE WITH YOUR PROFESSOR

Whenever you have a question about the content or activities, don't forget to post it to your course forum so that your classmates can read it.

You might not be the only one with the same question!

If you have a question that you only want to ask your professor, you can send him/her a private message from the Campus Virtual. And if you need to discuss something in more detail, you can arrange an advisory session with your professor.

It's a good idea to check the course forum on a regular basis and read the messages posted by your classmates and professors, as this can be another way to learn.

SCHEDULE OF ACTIVITIES

The activities will involve the application of the knowledge acquired in each of the thematic units that make up the course.

Week	Contents	Training/assessable activities	Academic model (indicate pillar)	SDGs (indicate which)	Weight in the evaluation of the evaluable activity
4	Activities / Cases	Unit 1	Professional Environments / Data Driven Approach	4, 7, 9, 13	
7	Activities / Cases	Unit 2	Professional Environments / Data Driven Approach	4, 7, 9, 13	
10	Activities / Cases	Unit 3	Professional Environments / Data Driven Approach	4, 7, 9, 13	
14	Partial Objective Test	Exam Units 1, 2, 3			
15	Activities / Cases	Unit 5	Professional Environments / Data Driven Approach	4, 7, 9, 11	

17	Report	Laboratory Practical Report	Simulated Environments		
18	Activities / Cases	Unit 6	Professional Environments / Data Driven Approach	4, 7, 9, 11	
	Partial Objective Test				

This timetable is subject to change and the student will be notified in due time and form.

DESCRIPTION OF THE ACTIVITIES DE EVALUACIÓN

Activities / Cases 1. Problems, cases, etc. related to the content of unit 1.
Activities / Cases 2. Problems, cases, etc. related to the content of unit 2.
Activities / Cases 3. Problems, cases, etc. related to the content of unit 2.
Activities / Cases 5. Problems, cases, etc. related to the content of unit 5.
Activities / Cases 6. Problems, cases, etc. related to the content of unit 6.
Laboratory Report. Descriptive report of the laboratory practices carried out in the course, as well as the results and their analysis.

RUBRIC FOR ACTIVITIES

RUBRIC FOR THE EVALUATION OF DELIVERABLES (ACTIVITIES, REPORTS, EXERCISES, ...)				
CALCULATION PROCEDURE	The calculation procedure used to solve the activity is totally incorrect.	The calculation procedure used to solve the activity is partially correct.	The calculation procedure used to solve the activity is mostly correct.	The calculation procedure used to solve the activity is completely correct.
ORDER AND ORGANIZATION	The delivered activity is neglected and disorganized. It is difficult to know what information is related.	The activity is generally presented in an orderly fashion, but there are some unconnected but there are some unconnected points.	The activity is presented in an orderly and organized manner and is generally easy to read and understand.	The activity is presented in a and organized, making it easy to organized, which makes it easy to understanding.
DIAGRAMS AND DRAWINGS (when required)	The activity does not include any diagrams or drawings to facilitate understanding.	The diagrams and drawings included in the activity are difficult to understand.	The diagrams and diagrams and drawings included in the activity are clear and easy to understand	The diagrams and drawings included in the activity are perfectly clear and help the help in the understanding of the the activity

EXPLANATION OF THE ACTIVITY	The explanation of the activity is difficult to understand and omits and omits key concepts key concepts	The explanation of the activity is difficult to understand but includes key concepts	The explanation of the activity is clear and incorporates the key concepts	The explanation of the activity is totally clear and detailed, including detailed, including all the key concepts all the key concepts
PHYSICAL AND MATHEMATICAL NOTATION	The basic physical and mathematical notation used to solve the activity (units, formal symbology, mathematical relations, operations, formulas, etc...) is totally incorrect.	The basic physical and mathematical notation used to solve the activity (units, formal symbology, mathematical relations, operations, formulas, etc...) is partially correct.	The basic physical and mathematical notation used to solve the activity (units, formal symbology, mathematical relations, operations, formulas, etc...) is correct.	The basic physical and mathematical notation used to solve the activity (units, formal symbology, mathematical relations, operations, formulas, etc...) demonstrates a complete understanding of how to solve the problems

NOTES:

- All items have the same weight (%) on the final rating.
- Papers with very poor presentation, with cross outs, etc. may not be evaluated.

RUBRIC FOR THE EVALUATION OF ATTITUDE AND PARTICIPATION IN THE CLASSROOM				
ATTITUDE	The student shows a passive attitude in the classroom and does not respond to the teacher's motivation.	The student shows a passive attitude in the classroom but responds to the teacher's encouragement.	The student shows an active attitude in the classroom classroom in more than 50% of the the sessions	The student shows an active attitude in the classroom classroom in more than 90% of the the sessions
PARTICIPATION	The student does not participate voluntarily in the classroom, not even at the at the request of the teacher	The student does not participate voluntarily in the classroom, but only when the teacher teacher requires it	The student participates voluntarily in the classroom in less than half of the activities activities throughout the semester	The student participates voluntarily in the classroom in more than half of the activities activities throughout the semester

NOTE: All items have the same weight (%) on the final rating.

PLAGIARISM RULES

In accordance with the disciplinary regulations for students of the Universidad Europea:

- Plagiarism, in whole or in part, of intellectual works of any kind is considered a very serious offence.

- Very serious misconduct relating to plagiarism and the use of fraudulent means to pass the assessment tests will result in the loss of the corresponding exam session, as well as the reflection of the misconduct and the reason for it in the academic record.