Universitat Autònoma de Barcelona

2022/2023

Thermodynamics Laboratory

Code: 100158
ECTS Credits: 5

Degree	Type	Year	Semester
2500097 Physics	OB	3	1

Contact

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Use of Languages

Principal working language: catalan (cat)
Some groups entirely in English: No
Some groups entirely in Catalan: Yes
Some groups entirely in Spanish: No

Prerequisites

They do not exist

Objectives and Contextualisation

The objectives of the practices of the Thermodynamics Laboratory can be summarized in:

1. Apply the fundamental laws and the theoretical principles of Thermodynamics.

2. Familiarize the student with an experimental subject: importance of the instrumentation in the design of experiments, use of measurement devices, acquisition of data in the laboratory, introduction in the methods of analysis of data, use of computers in the lab, etc.

3. Awakening in the student a critical mind regarding the level of confidence of their measurements, calculations and the interpretation of the results.

4. Motivate the student in the bibliographic research to interpret the experimental results and / or deepen other approaches to a particular experiment.

5. Promote experimental work and scientific discussion in a group

Competences

- Act with ethical responsibility and respect for fundamental rights and duties, diversity and democratic values.
- Communicate complex information in an effective, clear and concise manner, either orally, in writing or through ICTs, and before both specialist and general publics
- Develop strategies for analysis, synthesis and communication that allow the concepts of physics to be transmitted in educational and dissemination-based contexts
- Formulate and address physical problems identifying the most relevant principles and using approximations, if necessary, to reach a solution that must be presented, specifying assumptions and approximations
- Plan and perform, using appropriate methods, study, research or experimental measure and interpret and present the results.

- Take account of social, economic and environmental impacts when operating within one's own area of knowledge.
- Use computer tools (programming languages and software) suitable for the study of physical problems
- Use critical reasoning, show analytical skills, correctly use technical language and develop logical arguments
- Work independently, have personal initiative and self-organisational skills in achieving results, in planning and in executing a project
- Working in groups, assume shared responsibilities and interact professionally and constructively with others, showing absolute respect for their rights.

Learning Outcomes

1. Analyse and assess the adequacy of the assemblies prepared and carried out, in order to obtain measurements and the desired results.
2. Analyse the influence of various parameters on the simulation of an experiment.
3. Communicate complex information in an effective, clear and concise manner, either orally, in writing or through ICTs, in front of both specialist and general publics.
4. Correctly assess the uncertainty associated with a measure or set of measures.
5. Describe physical phenomena, identify variables, analyse the influence, presenting the results and conclusions of the work developed in a clear and precise manner.
6. Describe the function and manner of operation of the measuring instruments used.
7. Determine and measure the variables that describe a physical system.
8. Discriminate to the most important dependencies and draw the most conclusions from a set of experimental measurements.
9. Explain the explicit or implicit code of practice of one's own area of knowledge.
10. Foster discussion and critical thinking, evaluating the precision and characteristics of the results obtained.
11. Identify the social, economic and environmental implications of academic and professional activities within one's own area of knowledge.
12. Suitably present the results of a series of measures through graphs and perform linear regressions.
13. Use basic programmes to write reports and carry out basic data processing.
14. Use critical reasoning, show analytical skills, correctly use technical language and develop logical arguments
15. Use digital sensors for measuring magnitudes.
16. Work independently, take initiative itself, be able to organize to achieve results and to plan and execute a project.
17. Working in groups, assume shared responsibilities and interact professionally and constructively with others, showing absolute respect for their rights.
18. Write and present the results and conclusions of experimental work with rigor and conciseness.

Content

THEORY PROGRAM: (1 credit) (4 theory sessions of 2 hours)

- Computer and Laboratory

- Phase changes and phase diagrams of unary systems

- The temperature and its measurement

- The vacuum: obtaining and measuring

- The heat: propagation mechanisms. Calorimetry

PROGRAM OF LABORATORY PRACTICES: (4 credits) (7 laboratory sessions + 1 session of recovery)

I.- Heat propagation

II.- Calorimetry. Determination of specific calories

III.- Ideal gases

IV.- Real gases

V.- Phase transitions

VI.- Partial molar properties

VII.- Vacuum techniques, thermoelectric phenomena and thermal machines

Methodology

Lectures:

During the first weeks of the course, there will be between 3 and 4 introductory lectures in the Thermodynamics laboratory with the subject theory program. These lectures will consist of a set of presentations in PowerPoint. Students will have this content in sufficient time to follow the classes properly. Some videos related to the subject of the laboratory will also be screened.

Laboratory practices:

The students, in groups of 3 students, will complete a total of 7 laboratory sessions of approximately 3 hours and a half, during which 10 to 11 different practices will be carried out. Students will previously have the scripts of the practices for their preparation. There will be an additional laboratory session for the recovery of practices.

There are two different categories of practices: a) collective report practices (all practices except three) to present, through the Virtual Campus, a single report by group of practices after two weeks, natural, once the experience has been realized; and b) personal report practices (each member of the team will choose a report to be made) to present, through the Virtual Campus, at the end of the teaching period prior to the exam period.

The personal report must consist of the following parts: introduction and objectives, results and discussion, conclusions, bibliography and an annex showing the expressions used to evaluate uncertainties. Collective reports will only collect the results and their discussion, as well as the conclusions of the experiment.

The correction, by the teachers of the laboratory, of the collective reports, will allow to detect conceptual errors in its realization. The students will have an extra period of time in order to return the unsatisfactory reports.

All the results obtained in the laboratory must be correctly presented in tables with the uncertainties and the corresponding units. The uncertainties must have at most two significant figures, the final resultsmust be rounded out based on their uncertainties. The graphics must be presented with a title, the magnitudes represented, the corresponding units, the bars of uncertainties and the results of the adjustments if applicable.

Annotation: Within the schedule set by the centre or degree programme, 15 minutes of one class will be reserved for students to evaluate their lecturers and their courses or modules through questionnaires.

Activities

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
laboratory practices	30	1.2	1, 2, 6, 7, 10, 17, 15
lectures	10	0.4	1, 2, 6, 5, 8, 12, 15
Type: Autonomous			

personal working	35	1.4	2, 4, 5, 7, 8, 10, 12, 18, 16, 13
team working	47	1.88	4, 5, 7, 8, 10, 12, 18, 16, 17, 13

Assessment

Bloc/Apartat/Tema	Pes	Descripció
lab personal report	35%	work done by the student in the laboratory and evaluation of the personal lab report presented
team working	40%	work carried out by the group in the laboratory and evaluation of the lab collective reports presented
Examen escrit	25%	evaluation on the basic concepts explained in the previous lectures and on the basic concepts of the laboratory practices carried out. There is no repesca test. (It is mandatory to perform all laboratory practices, and the presentation of all reports of them, to have the right to take the exam, minimum grade of the written test to make average: 3.5)

The student will be considered evaluated if he / she has submitted to more than 35% of the final grade of evaluation

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
group work	40%	0	0	1, 2, 4, 3, 6, 5, 8, 9, 10, 11, 12, 14, 18, 17, 13
personal work	35%	0	0	1, 2, 4, 3, 6, 5, 7, 8, 9, 10, 11, 12, 14, 18, 16, 13
written exam	25%	3	0.12	2, 5, 7, 8, 16, 15

Bibliography

- M.D. Baró, G. Orriols, F. Pi, R. Pintó i S. Suriñach. *Tècniques Experimentals en Física*. Col. Materials, 37. Servei de Publicacions de la UAB, Barcelona,1997.
- G.Garcia, J.Bisquet, M.J.Hernández, S.Bal·le, Ll.Mañosa, *Introducció a l'experimentació*, Col. Ciències experimentals, Servei de Publicacions Universitat Jaume I, Castelló, 1999
- M.D. Baró, S. Bordas, J.A.Ibañez, J.E.Llebot, S.Suriñach. *Experiencias de Termodinámica*, Servicio de Publicaciones de la U.A.B. Bellaterra (Barcelona), 1985
- Notes of theory (Campus Virtual)

Software

This subject does not use any particular software