SUBJECT TEACHING GUIDE

G53 - Thermodynamics

Double Degree in Physics and Mathematics
Degree in Physics

Academic year 2020-2021

1. IDENTIFYING DATA					
Degree	Double Degree in Physics and Mathematics Degree in Physics			Type and Year	Compulsory. Year 2 Compulsory. Year 2
Faculty	Faculty of Sciences				
Discipline	Subject Area: Physics, Statistics and Thermodynamics Central Module				
Course unit title and code	G53 - Thermodynamics				
Number of ECTS credits allocated	6	Term		Semester based (1)	
Web					
Language of instruction	Spanish	English Friendly	No	Mode of delivery	Face-to-face

Department	DPTO. FISICA APLICADA
Name of lecturer	JOSE RAMON SOLANA QUIROS
E-mail	ramon.solana@unican.es
Office	Facultad de Ciencias. Planta: + 2. DESPACHO DE PROFESORES (2042)
Other lecturers	JOSE JULIO GÜEMEZ LEDESMA

3.1 LEARNING OUTCOMES

- - To understand the meaning and consequences of the Principles of Thermodynamics .

- To know to choose the adequate thermodynamic potential depending the characteristics of the system under study .

- To dominate the procedures to obtain the thermodynamic properties of a system on the basis of the thermodynamic potentials.

4. OBJECTIVES

- To implement the Thermodynamics as an essential part of Physics, Chemistry, and natural Sciences as a whole.

- To dominate the foundations of Thermodynamics and its applications.

- To provide the meaning of irreversibility as an index governing the unicity and meaning of natural phenomena.

6. COURSE ORGANIZATION

	CONTENTS
1	1.- BASICS CONCEPTS 1.1 Introduction to Thermodynamics, Kinetic Theory of Gases and Statistical Physics. 1.2.- Macroscopic and microscopic descriptions. 1.3.- Thermodynamic systems. 1.4.- Thermodynamic interactions. 1.5.- Equilibrium states. 1.6.- Thermodynamic variables. 1.7.- Changes of states and processes. 2.- TEMPERATURE 2.1.- Thermal equilibrium. Zero principle, 2.2.- Empirical temperature. Isotherms. 2.3.- Temperature scales. Thermometers. 2.4.- ideal gas temperature scale.- 2.5.- Empirical equation of state. Thermomechanical coefficients. 2.6.- Gases. 3.- FIRST PRINCIPLE 3.1.- Configurational work and dissipative work. 3.2.- Configurational work work in some reversible processes of an hydrostatic system. 3.3.- Calculation of work in some irreversible processes of hydrostatic systems. 3.4.- Adiabatic work. First principle. Internal energy. 3.5.- Heat. 3.6.- Energetic equation of state. 3.7.- Heat capacities of an hydrostatic system. 3.8.- Thermal and mechanical reservoirs.
2	4.- SECOND PRINCIPLE OF THERMODYNAMICS 4.1.- Statements of the second principle of Thermodynamics. 4.2.- Entropy. 4.3.- Absolute temperature. 4.4.- Properties of entropy. 4.5.- Irreversible processes. 4.6.- Equivalence between the several statements of the second principle of Thermodynamics. 4.7.- Thermal engines. Carnot cycle. 5.- THERMODYNAMIC POTENTIALS 5.1.- Internal energy. 5.2.- Entropy. 5.3.- Free energy. 5.4.- Enthalpy. 5.5.- Gibbs' potential. 5.6.- Grand canonical potential. 5.7.- Euler and Gibbs-Duhem equations. 5.8.- Relationships between potentials. 5.9.- Relationship between thermal and energetic equations of state. Mayer's generalized relation. 5.10.- Entropy of an ideal gas. 6.- EQUALIBRIUM AND STABILITY 6.1.- Condition of maximum entropy at equilibrium of an isolated system. 6.2.- Condition of minimum of the thermodynamic potentials at equilibrium of a system. 6.3.- Stability conditions. 7.- THIRD PRINCIPLE OF THERMODYNAMICS 7.1.- Chemical affinity. 7.2.- Statements of the third principle of Thermodynamics. 7.3.- Consequences of the third principle of Thermodynamics. 8.- PHASE TRANSITIONS 8.1.- Homogeneous and heterogeneous systems. Phases and components. 8.2.- Phase equilibria. Triple point and critical point. 8.3.- Classification of phase changes. 8.4.- First order phase changes and equations governing them. 8.5.- Second order phase changes and equations governing them. 8.6.- Lambda transitions. 8.7.- Equilibrium conditions of an heterogeneous multicomponent system. Gibbs' phase rule.

7. ASSESSMENT METHODS AND CRITERIA

Description	Type	Final Eval.	Reassessn	%
Solution of exercises (problems and questions indistinctly) by the student.	Written exam	Yes	Yes	50,00
Solution of exercises (problems and questions indistinctly) by the student.	Written exam	Yes	Yes	50,00
TOTAL				100,00

Observations

In each block the continuous evaluation will consists in the solution of several exercises by the student.

If the score in a block is over 5.0 the block will be considered passed independently of the score in the other block.

To average the score of a block with that of the other, a minimum score of 4.0 is required.

Each block not passed in the continuous evaluation can be passed in the final exam. The final exam will have a maximum duration of two ours for each block. For a block to be considered passed a minimum score of 5.0 is required. And the score is saved for the extraordinary exam. To average the score of a block with that of the other, a minimum score of 4.0 is required.

Observations for part-time students

Continuous evaluation:

2 partial exams (one for each block) with a weight of 50% each.

Minimum score in each block: 5.0. To average the score of a block with that of the other, a minimum score of 4.0 is required.

The recovery of a block will take place by means of the final exam in the same conditions as for the rest of the students.

8. BIBLIOGRAPHY AND TEACHING MATERIALS

BASIC

1.- Apuntes del profesor.