SUBJECT TEACHING GUIDE

G53 - Thermodynamics

Double Degree in Physics and Mathematics
Degree in Physics

Academic year 2016-2017

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	MODULE WITH SECOND COURSE SUBJECTS 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
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Other lecturers	JOSE JULIO GÜEMEZ LEDESMA

3.1 LEARNING OUTCOMES

- - To assimilate the basic concepts and postulates of thermodynamics.
- To know the content of the three principles of thermodynamics their consequences and applications.
- To dominate de method of thermodynamic potentials.
- To know how to deduce equilibrium and stability conditions.
- To know how to apply the conditions of phase equilibrium

4. OBJECTIVES

To implement the thermodynamics as an essential part of physics, chemistry and natural sciences on the whole.
To acquire the knowledge of the the foundations of thermodynamics and its applications.
To provide the meaning of irreversibility as an index governing the uniqueness and sense of natural phenomena.

6. COURSE ORGANIZATION

	CONTENTS
1	1.- BASIC 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.- State changes and processes. 2.- TEMPERATURE 2.1.- Thermal equilibrium. Zero principle. 2.2.- Empirical temperature. Isotherms. 2.3.- Temperature scales. 2.4.- Ideal gas temperature scale. 2.5.- Empirical equation of state. Thermomechanical coefficients. 2.6.- Gases. 3.- FIRST LAW 3.1.- Configurational work and dissipative work. 3.2.- Configurational work in some reversible processes of hydrostatic systems. 3.3.- Calculation of the work in some irreversible processes of hydrostatic systems. 3.4.- Adiabatic work. First law. Internal energy. 3.5.- Heat. 3.6.- Energetic equation of state. 3.7.- Heat capacities of an hydrostatic system. 3.8.- Thermal and mechanic focus.
2	4.- SECOND LAW OF THERMODYNAMICS 4.1.- Formulation of the second law of Thermodynamics. 4.2.- Entropy. 4.3.- Absolute temperature. 4.4.- Properties of entropy. 4.5.- Irreversible processes. 4.6.- Equivalence between the different formulations of the second law 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 the potentials. 5.9.- Relationship between the thermal and energetic equations of state. Generalized Mayer relationship. 5.10 Entropy of an ideal gas. 6.- EQUILIBRIUM AND STABILITY 6.1.- Condition of maximum entropy in the equilibrium of an isolated system. 6.2.- Conditions of minimum of the thermodynamic potentials in the equilibrium of a system. 6.3.- Stability conditions. 7. THIRD PRINCIPLE OF THERMODYNAMICS 7.1.- Chemical affinity. 7.2.- Formulations of the third law of Thermodynamics. 7.3.- Consequences of the third law 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 the phase changes. 8.4.- First-order phase transitions and their governing equations. 8.5.- Second-order phase transitions and their governing equations. 8.6.- Lambda transition. 8.7.- Equilibrium conditions in an heterogeneous multicomponent system. Gibbs phase rule.

7. ASSESSMENT METHODS AND CRITERIA

Description	Type	Final Eval.	Reassessn	%
1st bloc: solution of exercises by the student.	Written exam	Yes	Yes	50,00
2nd bloc: solution of exercises by the student.	Written exam	Yes	Yes	50,00
Final exam	Written exam	Yes	Yes	0,00
TOTAL				100,00

Observations

In each block the evaluation will consist of a series of tests, each of them consisting in the solution by the student of an exercise within the time of the lesson
As an indication, there will be a simple test for each chapter.
Eventually, because of limitations in time and /or work charge of the students, several tests of each block might be grouped in a single test, consisting in several exercises, to be done out of the time of the lesson in a date to be determined and with duration proportional to the number of exercises: 30-45 min for each exercise, approximately. Each exercise will be scored as an independent test.
If the score of a block is over 5.0 the block will be considered as approved, independently of the score obtained 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 approved in the continuous evaluation may be approved by means of a final examination. The final examination will have a maximum duration of two hour for each block. In order that a block be considered approved in the final examination a minimum score of 5.0 is required and the score will be maintained for the September examination. To average the score of a block with that of the other in the final examination, a minimum score of 4.0 is required.
In all tests it is allowed the use of books and notes.

Observations for part-time students

Continuous evaluation
2 partial exams (one for each block)

8. BIBLIOGRAPHY AND TEACHING MATERIALS

BASIC

1.- Fernández Pineda C. y Velasco Maíllo S. “Introducción a la Termodinámica”. Ed. Síntesis. Madrid, 2009.
2.- Zemansky M.W. y Dittman R.H. “Calor y termodinámica”. Ed. Mac Graw-Hill, México D.F. 6ª ed., 1985