

## Statistical Physics

Academic Year: ( 2022 / 2023 )

Review date: 14-06-2022

Department assigned to the subject: Physics Department

Coordinating teacher: SANCHEZ FERNANDEZ, LUIS RAUL

Type: Electives ECTS Credits : 6.0

Year : 1 Semester : 2

## REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

Basic knowledge of general physics and mathematics (graduate level).

## OBJECTIVES

The course will provide the student with an appropriate training in statistical physics especially suited for its application to plasma physics and nuclear fusion science.

Objectives:

1. Develop intuitive pictures of the micro- and the macroscopic world.
2. Distinguish between equilibrium and non-equilibrium states.
3. Understand the statistical origin of thermodynamic potentials.
4. Calculate the partition function of simple systems.
5. Apply mean-field theories to a variety of systems.
6. Understand criticality and universality.
7. Use transport equations.

## DESCRIPTION OF CONTENTS: PROGRAMME

1. Foundations: the microscopic and macroscopic world, ergodic hypothesis, the micro-canonical ensemble.
2. Canonical ensemble: derivation, thermodynamic potentials, fluctuations, applications.
3. Bose-Einstein gas: Bose-Einstein condensation, examples.
4. Fermi gas: Fermi distribution and Fermi energy, examples.
5. Phase transitions and critical phenomena: the Ising model, Van der Waals theory of liquids, critical phenomena, universality.
6. Non-equilibrium Statistical Physics: Boltzmann equation, Brownian motion, Langevin and Fokker-Plank equations, linear response, fluctuation-dissipation relations.

## LEARNING ACTIVITIES AND METHODOLOGY

\* Teaching Methods

- Classroom lectures and classroom problem solving sessions.
- Homework assignments.
- Small research project.

\* Course Material

- Lecture notes (in power point).
- Java experiments.

## ASSESSMENT SYSTEM

Evaluation Methods:

- Class participation: 10%
- Assignments: 20%
- Project: 20%
- Final exam: 50%

<b>% end-of-term-examination:</b>	50
<b>% of continuous assessment (assignments, laboratory, practicals...):</b>	50

#### BASIC BIBLIOGRAPHY

- D. Chandler Introduction to Modern Statistical Mechanics , Oxford U. Press, 1987

#### ADDITIONAL BIBLIOGRAPHY

- Kerson Huang Statistical Mechanics, Wiley, 1987
- W. Greiner, L. Neise, H. Stocker Thermodynamics and Statistical Mechanics, Springer, 1995