



UNIVERSITÀ  
DEGLI STUDI DI MILANO-BICOCCA

## SYLLABUS DEL CORSO

### Statistical Mechanics

2627-1-F1703Q062

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#### Aims

**Knowledge and understanding:**

The student will acquire a rigorous and advanced understanding of classical and quantum statistical mechanics, statistical ensembles, ideal and interacting gases, phase transitions, and the renormalization group.

**Applying knowledge and understanding:**

The student will be able to apply statistical mechanics methods to the quantitative analysis of complex systems and to develop theoretical models consistent with physical behavior.

**Making judgements:**

The student will develop the ability to critically assess models and methods, selecting the most appropriate tools for the system under study.

**Communication skills:**

The student will be able to present concepts and techniques of statistical mechanics clearly, rigorously, and with formal precision.

**Learning skills:**

The student will acquire the theoretical tools necessary to independently deepen advanced topics in statistical mechanics and condensed matter physics.

#### Contents

Statistical ensembles, derivation of the equation of state for classical and quantum gases, theory phases transitions, critical phenomena and renormalization group.

## **Detailed program**

Equilibrium and Statistical Mechanics. Statistical ensembles. Liouville theorem. Microcanonical, Canonical and Grandcanonical ensembles. Ideal and Interacting classic gases, the cumulant-expansion. Quantum gases Fermi-Dirac and Bose-Einstein distributions. Phonon and Photon gases.

Phases transitions and critical phenomena. Van-der-waals equation. Ising model. Landau and Landau-Ginsburg theories. Renormalization Group.

## **Prerequisites**

## **Teaching form**

Frontal teaching (42 hours)

## **Textbook and teaching resource**

Mehran Kardar, *Statistical Physics of Particles*, Cambridge University Press.  
Landau-Lifshitz, *Statistical Physics (part I)*, Elsevier.  
Kerson Huang, *"Statistical mechanics"* John Wiley & Sons.

## **Semester**

Semester I

## **Assessment method**

Oral exam concerning the topics discussed during the course. Students can be asked to reproduce in detail the demonstrations seen in class.

## **Office hours**

Email me to fix an appointment at: [sara.pasquetti@unimib.it](mailto:sara.pasquetti@unimib.it)

## Sustainable Development Goals

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