TCSS6AB STATISTICAL PHYSICS

TCSS6AB Statistical Physics	Duration : 30 hours	ECTS Credits : 3.5	Semester : S6

Person(s) in charge :

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Keywords : Global behavior of complex systems, quantum and classic systems, Modelling

Prerequisites : Quantum physics(TCS12), Statistics (TCS15), Physics level of Preparatory classes

Objective :

Deduct properties from macroscopic scaled systems with laws that rule elementary matter at microscopic scales.

Program and Content :

Statistical physics is a part from Physics that studies the global behavior of systems made of a lot of particles, with the aim to establish a link between macroscopical physics and microscopical laws that rule the elementary constituents of these macroscopical systems. It was initially developed to explain Thermodynamics, but then grew up to model complex systems, in-which particles can be concrete objects (electron, atoms, molecules, grains of sand) but also more abstract objects (economical agents, bits of information). Hence statistical physics remains one of the pillar of modern physics. Crossing many areas, it is still facing major scientific challenges with strong societal issues. It is then a key discipline for the engineers of the next century.

1 - Introduction
Orders of magnitude - Statistical description of a physical system - Thermodynamic Potentials
2 - Statistical Description of an isolated system
Fundamental postulate - microcanonical ensemble
3 - statistical description of a system in contact with a thermostat
Partition function; Canonical ensemble; Generalization to the case of the grand canonical ensemble
4 - The classic ideal gas
Ideal gas in equilibrium - Kinetic theory of gases - Transport Phenomena
5 - Classical and Statistical Thermodynamics
How classical laws of thermodynamics are explained by a statistical approach; Lagrange multipliers; Statistical physics and information theory; Shannon entropy
6 - Perfect quantum gas
Fermi-Dirac statistics and Bose-Einstein statistics
7 - Perfect gas of fermions
Density of states; Physical and thermodynamic properties; Applications to the electron gas in metals
8 - Introduction to semiconductors
Electronic Strutures of Solids; Conduction of semiconductor materials
9 - Perfect Gas of bosons
Photon gas; Phonon gas; Bose-Einstein

The content may be seen in a different order, depending on scheduling constraints.

Abilities:

Levels	Description and operational verbs
Know	The fundamental postulate, fundamental concepts and models developed in the course. Statistical ensembles Quantum statistics (Fermi-Dirac & Bose-Einstein)
Understand	Different fundamental models developed in the course, with their hypothesis and the validity of the forecasts they allow to obtain.
Apply	The general method of a resolution of a problem in Statistical physics, The modelling approach to understand, use, predict, a given physical property. The method to prepare and present a poster on a topic directly linked to both the biggest scientific and technological applications of Statistical physics
Analyze	A complex system to turn it into a system which can be processed.
Summarise	Data gathered to prepare a poster on a topic directly linked to both the biggest scientific and technological applications of Statistical physics Data describing a physical system.
Assess	Relevance of a result Order of size

Evaluations :

☑ Written test	☑ Continuous Control	☑ Oral report	☐ Project	☐ Written report