Preface

This book is intended for students who begin for the first time the study of statistical mechanics. There are two different approaches to teach thermal physics to the physics students at the level of BSc. The first is to expose the subject in two separate courses: one in thermodynamics, i.e. the macroscopic aspect of thermal physics, and a second one (taught immediately after the first) in statistical mechanics, i.e. the microscopic aspect. There are excellent books that choose this way. The other approach is to present the subject in only one course, mixing the two aspects. Excellent books that follow this more compact method also exist. Here there is no place to discuss the advantages and the disadvantages of each of the two approaches. In this book, I follow the first one. This means that this course is suited for students that already have some knowledge in thermodynamics.

Historically, classical statistical mechanics was first developed and only later, with the progress of quantum theory, the quantum statistical mechanics was born. I think that, from a pedagogical point of view, it is easier to teach the quantum statistical mechanics than its classical counterpart. This is the reason why the main part of this book is devoted to the quantum statistical mechanics. It suffices that the student has elementary knowledge of the basic results of the quantum theory to be able to understand the matter.

This book may appear very short. In fact, it is effectively far form being complete. For example, in thermodynamics the concept of entropy is introduced in connection with irreversible process.

However, in this book, I did not discuss this problem, giving time for student to study it later.

I tried to present the subject in a consistent form: first the general principles or the methods giving the links between the macroscopic and the microscopic worlds. In addition, in the second part, applications to simple situations are developed. It is good to give first the foundations and only afterwards the details of the applications. On the other side, I present classical cases as particular situations of quantum cases. This is not the way in which the matter is frequently taught. I think that the actual presentation has some novel aspect. The mathematical level is not very high. The reader has to be familiar with algebraic calculus, combinatorics, differential and integral calculus.

The book is almost exclusively for students. It is based on my personal teaching at the Technion. At the disposal of the teacher, there are many very good books with a lot of complementary details for an oral teaching in the classroom. But I did not find a book that I can recommend to the students when, for example, he was not able to assist some classes. When I taught this course, I had only two hours a week (and one hour for exercises) during one semester of 14 weeks. In such limited time, only the main points may be taught. This means that all is important in the book. It represents what a student needs to know in order to be able to follow others courses in his studies toward his first degree in physics (for example, a course in solid state physics). I introduced exercises which are straightforward applications of the matter of each chapter. They will help the student to assimilate the main concepts and methods.

I added a special chapter on the history of statistical mechanics. Since in the book itself I do not follow the historical development, I thought this could be interesting to bring about some views on how the theory was built.

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