

# Preface

Probably as many reasons have been given for writing books on classical mechanics as there are books on the subject. So perhaps we will be forgiven for not adding to the list of reasons as we add to the already excellent and extensive list of books devoted to this subject.

The present text is based in a large part on lectures given on the subject of classical mechanics to senior students. It represents a physicist's view of mechanics, presented to an audience of potential physicists (not mathematicians) who would one day earn their keep in physics. With these initial conditions it became clear that emphasizing the application of the principles of mechanics to problems usually encountered by the physicists is to be preferred over an exposition that stresses the more mathematical aspects of mechanics in their own right. So, some readers may well judge a given mathematical proof, let us say in the calculus of variations, for example, as lacking rigor. That is fine we say. Let that person dig deeper into books on that particular subject. But it is well to remember that there are various levels of rigor in mathematical demonstrations (the last one being *rigor mortis* as was once pointed out to us!) within a subject whose foundations rest in the final analysis on experience and experiment. These remarks must in no way be construed as condoning a careless attitude in *using* mathematics in the process of reasoning in mechanics. We simply stress that mechanics is not mathematics and one should not confuse the two.

It is also well to remark on the choice of material and the emphasis within that choice, that is to be found here. Since this book is aimed at senior students who have already had some substantial experience in the methodology of mechanics, up to and including Lagrangian mechanics, our attitude is one of leading the already converted into the more elegant formulations of the subject, based on variational principles of various kinds. This approach leads naturally to the introduction of the Lagrange function and Lagrange's equations again. Once the Lagrange function, its properties, and the Lagrange equations have been established, we take pains to tackle every new problem from this vantage point. Thus, the build-up from point mechanics to rigid bodies to small vibrations to fluids all happens from a unified point of view.

Special Relativity is a traditional and essential part of mechanics today. However, it is also a somewhat less familiar element, and consequently the subject of a more elementary discussion. The same comment is true for the discussion of fluid motion. We end the book with Hamiltonian mechanics, including a discussion of perturbations and Hamilton-Jacobi theory which is usual, as well as a demonstration of the introduction of *uncertainty* in mechanics, due to Max Born, which is unusual.

Apart from Chapter 1, which is essential for understanding the rest of the book, each succeeding chapter is more or less independent of its predecessor.

A comment on problems in mechanics is also relevant. The text contains a fair number of worked examples that usually serve as illustrations of the principle on which the problem is based. A list of problems will also be found at the end of each chapter. The purpose of most of these problems is again to illustrate some aspect not fully discussed in the text itself. It has not been our purpose to compile an exhaustive list of problems, although we urge the reader to find and do as many as they can lay their hands on. A very useful source of physical problems in classical mechanics is G.L. Kotkin and V.G. Serbo, *Exploring Classical Mechanics*, (Oxford University Press, Oxford, 2020).

In writing a book of this nature, one is inevitably influenced by teachers of, and books on the same subject. As with most textbooks, this one also grew out of coursework. All students in a course play a larger role than they often think in influencing the purpose (and horizons) of that course, and one of us (SPK) was in fact one of the subjects on which this course was practised. This book has taken an extremely long time in its production, due to our other obligations, with the unfortunate consequence that RHL has in the meantime sadly passed away. Consequently, I am hoping that, looking down from his place in physics heaven, he approves of all the changes that have been made.

Finally a special word of thanks is due to all those student assistants who have painstakingly helped put this manuscript together.

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