PREFACE

This volume is an attempt to bring together a compendium of physics at the graduate level. It is at the same time a summary of the basic subject matter that a physicist learns during the first two years of a doctoral program, and a précis of much of what he or she frequently has occasion to look up during his or her subsequent academic and/or industrial career.

Most of the chapters contain material that graduate students must know before taking the PhD qualifying (admission to candidacy) examination. The first draft of the manuscript was assembled from notes I had accumulated during twenty years of teaching a qualifying examination preparation course. During these years the students asked many questions and provided comments on the lecture notes that were very helpful in improving the work. Each student enrolled in the course was required to teach two of the sessions, and this gave me the opportunity to listen to the subject matter of the chapters from a student's viewpoint. I am indebted to these students for their insights.

The handbook aspects of this volume are the result of my keeping track of the various things that I have looked up in reference books during my 40-year career as both an industrial and an academic physicist. Some types of information are needed quite often, such as matrix algebra and vector identities, together with special functions like Legendre polynomials, and these are found in the last two chapters. Other types of information are needed

more occasionally such as clarifications of concepts involving Lagrangians, parity, dispersion relations, chaos, free energies, statistical mechanical ensembles, and elementary particle classifications, and these materials are spread throughout the remainder of the chapters.

This volume should be useful for its original intent, namely providing a convenient vehicle for reviewing graduate-level physics in preparation for the qualifying examination. However its greatest value will doubtless be to the community of working physicists who can benefit from a one-volume compendium of fundamental concepts and key equations. There are frequent occasions during the working life of a physicist when it is necessary to refresh one's memory concerning basic questions of theory or practice that were learned years before, and this volume attempts to satisfy that need. I hope that it will serve both of these purposes well.

It has been very satisfying to spend the beginning of my formal retirement gathering together in one volume things that I initially learned as a graduate student at Fordham and the University of Maryland during the early 1950s, such as classical mechanics, electrodynamics, and quantum mechanics, together with more recently acquired knowledge on topics such as closed-form solutions to the three-body problem, elementary particles, and chaos. A number of interesting topics including many of the useful function and formula tabulations in the final two chapters were added at the recommendation of several reviewers to whom I am thankful. I also wish to thank my son Michael for drawing many of the figures.