FUNDAMENTALS OF NUCLEAR SCIENCE AND ENGINEERING

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Preface

Nuclear engineering and the technology developed by this discipline began and reached an amazing level of maturity within the past 60 years. Although nuclear and atomic radiation had been used during the first half of the twentieth century, mainly for medical purposes, nuclear technology as a distinct engineering discipline began after World War II with the first efforts at harnessing nuclear energy for electrical power production and propulsion of ships. During the second half of the twentieth century, many innovative uses of nuclear radiation were introduced in the physical and life sciences, in industry and agriculture, and in space exploration.

The purpose of this book is two-fold as is apparent from the table of contents. The first half of the book is intended to serve as a review of the important results of "modern" physics and as an introduction to the basic nuclear science needed by a student embarking on the study of nuclear engineering and technology. Later in this book, we introduce the theory of nuclear reactors and its applications for electrical power production and propulsion. We also survey many other applications of nuclear technology encountered in space research, industry, and medicine.

The subjects presented in this book were conceived and developed by others. Our role is that of reporters who have taught nuclear engineering for more years than we care to admit. Our teaching and research have benefited from the efforts of many people. The host of researchers and technicians who have brought nuclear technology to its present level of maturity are too many to credit here. Only their important results are presented in this book. For their efforts, which have greatly benefited all nuclear engineers, not least ourselves, we extend our deepest appreciation. As university professors we have enjoyed learning of the work of our colleagues. We hope our present and future students also will appreciate these past accomplishments and will build on them to achieve even more useful applications of nuclear technology. We believe the uses of nuclear science and engineering will continue to play an important role in the betterment of human life.

At a more practical level, this book evolved from an effort at introducing a nuclear engineering option into a much larger mechanical engineering program at Kansas State University. This book was designed to serve both as an introduction to the students in the nuclear engineering option and as a text for other engineering students who want to obtain an overview of nuclear science and engineering. We

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believe that all modern engineering students need to understand the basic aspects of nuclear science engineering such as radioactivity and radiation doses and their hazards.

Many people have contributed to this book. First and foremost we thank our colleagues Dean Eckhoff and Fred Merklin, whose initial collection of notes for an introductory course in nuclear engineering motivated our present book intended for a larger purpose and audience. We thank Professor Gale Simons, who helped prepare an early draft of the chapter on radiation detection. Finally, many revisions have been made in response to comments and suggestions made by our students on whom we have experimented with earlier versions of the manuscript. Finally, the camera copy given the publisher has been prepared by us using LaTeX, and, thus, we must accept responsibility for all errors, typographical and other, that appear in this book.

J. Kenneth Shultis and Richard E. Faw

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