BOOK REVIEWS

Selection of books for review is based on the editors' opinions regarding possible reader interest and on the availability of the book to the editors. Occasional selections may include books on topics somewhat peripheral to the subject matter ordinarily considered acceptable.

Dynamics of Nuclear Reactors

Author David L. Hetrick

Publisher University of Chicago Press

Pages 542

Price $18.50

Reviewer M. A. Schultz

The subject of reactor dynamics has from the beginning of nuclear reactor technology fascinated many people. Hundreds of articles have been written on the subject, as well as dozens of books. The reason for this popularity is that reactor dynamics problems are useful excercises that not only have manageable mathematical solutions, but also that the approximations to these solutions give real life answers accurate enough to be used for design purposes. However, many problem solvers in the field have continually reinvented the wheel and provided several different forms of solutions especially formulated for their own particular problem.

Consequently, it was a real delight to see much of this material carefully put together, summarized using one set of common notation, and cleaned up in a logical fashion. The University of Arizona has long been in the forefront of teaching and writing in the fields of reactor kinetics and dynamics and Professor Hetrick's new book will further advance that position.

The book is stated to be used as a text for undergraduate seniors and graduate students in nuclear engineering. Mathematical knowledge of differential equations, Laplace transforms, and an acquaintanceship with matrices are required. This knowledge will get the reader through the first two thirds of the book, but it is likely that beyond Chap. 7 the text will be found most suitable for bright graduate students.

The text is concerned mostly with point source black-box reactor dynamics and every conceivable type of input including variations on steady state, ramp, step, and sine wave inputs are extensively treated. The concept of the transfer function is developed, as are hypergeometric functions and integral solutions. Numerous forms of output solutions for these various inputs are provided. All the common approximate solutions are also presented.

The text then works its way into feedback situations and, of course, when one mentions feedback, the subject of stability always arises. In our field, which from the beginning has borrowed heavily from other fields, a dazzling array of stability criteria have been used and the student is often puzzled in trying to give a simple answer to the question, "Is it stable?"

Happily, Hetrick logically straightens this out. The reader is led through all the common stability criteria starting with Routh, Niquist, and root-locus methods for linear reactor systems. The methods and criteria of Liapunov, Welton, Lagrange, and Popov are introduced in the handling of nonlinear stability problems and by the conclusion of Chap. 7 the stability situation is nicely placed in its proper perspective.

The text then goes on into space-dependent neutron dynamics and again the numerous articles in the field are compressed and fitted into general approaches. Numerical methods of handling the spatial problems are presented with some emphasis being placed on Kaplan's type of solution. The text concludes with a short summary of neutron waves. This section may or may not be appropriate but, because it is an area of progression into which many of the advanced dynamacists ultimately attain, it seems useful to leave the student in an open area in which he can extend his own curiosity.

All reviewers must be critical of something to retain their status, but I find it hard to be critical with this book because it answers most of the usual classroom questions. The book might have been a shade more helpful for classroom work if more practical design examples had been used. The problem of how one translates analytical expressions into the design of devices that move control rods is one that many students anticipate with trepidation.

M. A. Schultz (BS, electrical engineering, MIT, 1939) is presently a professor of nuclear engineering at The Pennsylvania State University, after 30 years of industrial experience, 20 of which were in the nuclear reactor field. He is the author of one of the first books on reactor dynamics and control and together with his friend, Joe Harrer, succeeded in maintaining a monopoly in this field for many years.

Nuclear Reactor Theory

Authors George I. Bell and Samuel Glasstone

Publisher Van Nostrand Reinhold Company

Pages 619

Price $24.50

Reviewer Dale R. Metcalf

This book is highly mathematical in content and provides a treatment of some topics in advanced reactor theory that are not found except as scattered throughout the literature. This book could be used as a text or main reference book in a course in advanced reactor theory. Problems are provided at the end of each chapter to test the understanding of the student and an extensive list of excellent references are given at the end of each chapter to supplement the reading material. If this text were to be used as a text book, adequate coverage of the material would require at least two semesters.

There are ten chapters in the book. The first chapter considers the derivation of the neutron transport equation from simple balance considerations and the last two chapters treat reactor dynamics.

The derivation of the transport equation is followed by a discussion of its limitations and the general methods of solution. Chapter 2 introduces the reader to the solution of the one-speed transport equation with emphasis on exact methods using Case's method of separation of variables and singular eigenfunctions.

While the emphasis in Chap. 2 is on analytical methods of solution to the one-speed transport equation, Chap. 3 treats the same problem using numerical methods. Difference equations are derived for the diffusion equation in both one-and two-dimensional rectangular geometries.

Multigroup methods are then discussed in Chap. 4 with emphasis on diffusion theory. The problem of obtaining suitable multigroup cross sections is discussed, although not in sufficient detail for the average reader to understand in depth the theory and numerical analysis of present reactor codes for preparing group constants.

A fairly brief treatment of discrete ordinates and S_n methods is provided in Chap. 5, which comes as somewhat of a surprise because of the strong emphasis on this method of solution in present day research.

The adjoint equation with its application to perturbation theory and variational methods is discussed in Chap. 6. Relevant application of both techniques are given which aid to a better understanding of the theory.

Chapter 7 provides a fairly comprehensive treatment of neutron thermalization. A knowledge of quantum mechanics is essential to a more complete understanding of this section. There are 123 references given at the end of this chapter; therefore, anyone studying thermalization theory in depth can consult the references for complete details of the derivations and an in-depth understanding of the material.

Resonance absorption is treated in Chap. 7 with 130 references provided at the end of this chapter. This reviewer succeeded in extracting certain parts of Chap. 8 into a second semester course in reactor theory at the undergraduate level, thus introducing the students to problems of resonance absorption in homogeneous and heterogeneous systems.

Finally, in the last two chapters reactor dynamics is treated, Chap. 9 studying the point reactor model and Chap. 10 treating spatial reactor dynamics. This last chapter treats the important problems of xenon oscillations and long-term reactor burnup.

The Appendix provides a discussion of some nonelementary mathematical functions used more or less extensively in the body of the text.

In summary, this book is a useful addition to the worker in reactor theory. The writing style and format is well presented which is typical of previous writings of these authors. The content of the book is extensive although there are numerous places where the development is not as complete as one might desire. Normally adequate references are cited for a more thorough treatment of the subject under discussion.

Dale R. Metcalf, associate professor of nuclear engineering at the University of Virginia, graduated from the University of Utah and received his PhD degree in nuclear science from the University of Michigan. His work in nuclear engineering started in 1956 with Phillips Petroleum Company at the National Reactor Testing Station in Idaho. He participated actively in the nuclear design of such high flux test reactors as the Engineering Test Reactor, the Advanced Test Reactor, and SPERT reactors. He has been with the University of Virginia since 1967. His interests include neutron transport theory, applied mathematics, and physics and reactor theory.

PUBLICATIONS COMPILED BY STAFF EDITORS OF IAEA

Publisher Unipub, Inc.

Reviewer Stanley J. Malsky

Directory of Whole-Body Radioactivity Monitors

(1970 Edition: International Atomic Energy Agency, Vienna, 1970)

Pages 900

Price $25.00

This directory should be of interest to health, medical, and nuclear physicists; architects; administrators of whole-body counting facilities; and instrumentation and construction engineers.

The data as reported in this world directory were obtained from persons operating (182) or having advanced (24) plans for the operation of whole-body counters and ancillary systems.

The present directory is to be supplemented with additional information as the need develops for new information or systems.

The directory makes use of floor plans, tables, charts, and lists of and types of equipment in use for each of the establishments presented therein. Data sheet information on individual monitors is broadly defined into the following main sections:

1. general data
2. methods
3. monitoring room specifications
4. detectors and geometry considerations
5. ancillary equipment
6. calibration data
7. shielding and room dimensions
8. heating, cooling, ventilation, etc.

Each of the main categories is subdivided into specifics as related to each laboratory.

Uses of the monitors include human-natural activity studies, human-artificial activity studies, and animal, food, and physical studies.

The detailed and specific information contained in this directory