Book Review

Fundamentals of Nuclear Science and Engineering, 3rd edition. By J. Kenneth Shultis and Richard E. Faw. CRC Press (2016). Price $159.95.

Reviewer: James G. Miller

Over the past several years I have taught a number of undergraduate- and graduate-level introductory courses in nuclear engineering using *Fundamentals of Nuclear Science and Engineering* as the preferred text. Compared to its rivals, its coverage of key topics is for the most part more comprehensive, better organized, and easier for the students to follow. Having used the second edition in the past, I am switching to the newly released third edition for future courses.

The strengths of the Shultis and Faw text start with a detailed, adequately rigorous, and thorough coverage of the applicable atomic and nuclear physics behind nuclear engineering. One example of this is its discussion of the threshold energy for a nuclear reaction. Whereas many rival texts either ignore the topic or mention only kinematic threshold energy, *Fundamentals of Nuclear Science and Engineering* includes coverage of both kinematic and Coulombic threshold energy, the latter being necessary for understanding the difficulty of achieving sustained nuclear fusion. The derivation of the general kinematics equation for a binary two-product nuclear reaction is another item often absent from rival texts, as is the inclusion of extensive tables of nuclear data, conveniently located in the text appendices. Among the data tables provided are detailed individual nuclide data, cross-section data for both neutron and photons, and radioactive decay data for a large number of radioisotopes. These data tables will be of continuing value to students taking additional coursework in nuclear engineering.

In addition to the extensive coverage of relevant nuclear and atomic physics, as well as a general introduction to nuclear reactors and nuclear power, the text includes material on radiation detection and measurement, health physics, fusion, industrial and research applications, and nuclear medicine. One minor complaint about the text's organization is the inclusion of physical constant and conversion factor data in the first chapter, whereas such information would be more conveniently located in an appendix.

For the most part, differences between the second edition and the third edition are minimal. A number of the third edition chapters include expanded problem sets. The chapter on radiation doses and hazard now includes a discussion of hormesis, and the contents of the chapters on reactor theory and proposed reactor designs have been substantially expanded.

As is the case with most textbooks, the available material is more than can be covered in a single-semester course. On the other hand, I would like to see more discussion of nuclear power plant operation and design, including nuclear heat transport and energy conversion, as well as a more quantitative discussion of the nuclear fuel cycle. Because I teach a course in nuclear engineering to mechanical engineering students that focuses less on the nuclear physics background of nuclear engineering and more on nuclear power, the inclusion of this additional material would make Shultis and Faw the ideal choice for such a course.

I highly recommend *Fundamentals of Nuclear Science and Engineering* for introductory-level courses in nuclear engineering, especially those with a more intense focus on the nuclear physics behind the engineering. The text can serve as a valuable resource and reference, not only for students taking more advanced courses in the various areas of nuclear engineering, but for working professionals as well.

About the Reviewer: James Miller is a professional engineer with over 30 years of experience in the nuclear industry. As a nuclear utility engineer, he provided methods development support in the fields of reactor core design, fuel performance, and safety analysis including the submission of topical reviews on analytical methods to the U.S. Nuclear Regulatory Commission. He is presently an Assistant Professor in the Department of Mechanical and Nuclear Engineering at Virginia Commonwealth University with primary interests in engineering education and reactor simulation.