Review of Reliability Engineering: Theory and Practice Sixth Edition by Prof. Dr. Alessandro Birolini, . Swiss Federal Institute of Technology (ETH), Zurich, Switzerland, ISBN 978-3-642-14951-1, e-ISBN 978-3-642-14952-8, Springer,

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Professor Dr. Alessandro Birolini of the Swiss Federal Institute of Technology (ETH), Zurich, Switzerland, has published the sixth edition of his excellent book entitled Reliability Engineering: Theory and Practice. This is a very readable book that is suitable as both an instructional text and a reference. This reviewer highly recommends this book.

This edition follows the general format of the previous editions: eight chapters and eleven appendices. The chapters address:

1. Basic concepts, Quality and Reliability Assurance of Complex Equipment & Systems
2. Reliability Analysis During the Design Phase
3. Qualification Tests for Components and Assemblies
4. Maintainability Analysis
5. Design Guidelines for Reliability, Maintainability, and Software Quality
6. Reliability and Availability of Repairable Systems
7. Statistical Quality Control and Reliability Tests
8. Quality and Reliability Assurance During the Production Phase

The appendices address

1. Terms and Definitions
2. Quality and Reliability Standards
3. Definition and Realization of Quality and Reliability Requirements
4. Checklists for Design Reviews
5. Requirements for Quality Data Reporting Systems
6. Basic Probability Theory
7. Basic Stochastic-Processes Theory
8. Basic Mathematical Statistics
9. Tables and Charts
10. Basic Technological Component's Properties
11. Problems for Homework

There are also a brief list of Acronyms and comprehensive References and Index sections.

This edition reviews, refines, and extends the previous editions. In particular, it includes an introduction to network reliability, binary decision diagrams, events trees, and basic considerations for large, complex systems. The edition expands the examination of

maintenance strategies by considering the effects of travel times for repair and redundant configurations with more than one repair crew. It examines repairable, redundant configurations with repair crews. There is an important discussion on the distinction between failure rate and density or intensity of a point process, as well as on the concepts of as-good-as-new and as-bad-as-old. This edition presents a simple proof that a repairable 1-out-of-2 redundancy with constant failure and repair rates behaves almost like a one item with constant failure and repair rates. Also, this edition includes design rules for lead-free soldering. It carefully considers statistical reliability tests and examines the application of an acceleration factor to failure free times in accelerated testing.

This book treats both basic and sophisticated reliability concepts extremely well. Descriptions are concise, yet quite sufficient. It uses mathematics when necessary to convey or quantify important concepts. Several of the appendices provide the mathematical and statistical underpinnings of the reliability discipline. Moving such information to appendices allows the author to maintain the flow of important programmatic and analytical concepts without being bogged down in mathematical details. The author should be congratulated for his approach.

In many places, the book describes the interconnections among reliability, maintainability, and availability. It describes the interconnection in a sophisticated analytical manner in its comprehensive treatment of repairable systems. There are design guidelines for maintainability and testability, although these are somewhat brief. What is particularly good is that the impact of travel time for maintenance receives the consideration that it deserves. Too often, systems are designed without adequate consideration of the travel time that is involved in maintenance actions.

This reviewer found all of the parts of this book easy to read and appropriately supported with figures and tables, examples, and problems for homework. There is a very helpful table on basic technological component properties. This table, in Appendix A10, includes failure modes and component sensitivities that make the table a ready reference for design and test engineers. Although not in tabular format, the checklists for design review provide useful starting points for the design reviews of systems in the different phases of development. A reader could consider these checklists as starting lists that could be expanded to suit the particular phase of development and the particular nature of the system under review.

For those like the reviewer, who has an active interest in the “front end” of system development, the text includes a short section on reliability allocation, an activity that often does not receive sufficient attention during system design. The described allocation method is a simple one that is adequate for many purposes, but there also is mention of reliability optimization. In a subsequent edition, the author might expand the treatment of reliability allocation to the problem of allocating reliability subject to various types of constraints that might encountered in real-world system developments.

The physics of failures are addressed through sections on the failure mechanisms and failure analysis of electronic components and the failure analysis of electronic components. The procedure for failure analysis is illustrated in a very nice flow chart. The failure mechanisms section includes a table of basic failure mechanisms of integrated circuits in plastic packages. While a physics-of-failure specialist might realize that the presentation of the topic is necessarily introductory, most reliability practitioners will find the presentation adequate for many circumstances, especially when they also consider the aforementioned Appendix A10.

System reliability is governed within the system itself by the reliability and quality of the hardware and software and the reliable performance of the humans associated with the system. Although the text acknowledges the possibility of human errors in several places, it focuses on hardware and software and does not provide a treatment of the role of human performance reliability in operation and maintenance. As mentioned above, there are brief maintainability design guidelines that could reduce human errors in maintenance. Although systems are becoming more and more automated, it will be several decades at least before humans are completely eliminated from system operation. Even with advent completely automated system operation, the subject of designing to reduce maintenance-induced failures will require attention. It will be interesting to see if the author will address the reliable human performance in operation and maintenance in future editions.

This reviewer recommends this text highly to reliability practitioners and students. He thanks Professor Dr. Birolini for the opportunity to review the book and for providing the review copy.