

Preface

The scope of reliability engineering is extremely wide, encompassing many areas of engineering technology. Reliability engineering helps ensure the success of space missions, maintain the national security, deliver a steady supply of electric power, provide reliable transportation, and so on. There has been a considerable growth of knowledge in several areas of reliability engineering and its applications. These areas are characterized either by specific methodologies—fault trees, for example—that have found applications across various disciplines, or by topics that have developed a structure of their own, like power system reliability. New definitions, concepts, and techniques have been developed in these areas, and the knowledge of generic reliability theory alone is not enough for the appreciation of these ideas.

Reliability engineers deal with projects relating to various disciplines or with discrete aspects of a complex project and need the knowledge of diverse topics. An engineer needing information in these areas generally faces a great deal of difficulty and inconvenience, since these topics are discussed in various technical papers and in specialized books but have not been treated within the framework of a single book. This book is intended to fulfill the need for a single volume that considers these diverse topics. In this book topics of current interest are treated in such a manner that the reader needs no previous knowledge to understand the contents. We have tried to focus more on the structure of the concepts than the minute details. References to relevant literature are provided for the reader who wants to delve more deeply into particular topics.

The first chapter reviews the role and importance of reliability engineering in the planning and design process and outlines the scope of the book. Chapter 2 reviews the basic probability theory and other pertinent mathematical topics. Fundamental concepts and reliability techniques are described in Chapter 3. For readers not familiar with the basic concepts of

reliability theory, these two chapters provide sufficient background for understanding this book.

Subsequent chapters deal with important techniques and specific areas of application. These chapters are self-contained and the reader with some background in reliability can understand them without referring to Chapters 2 and 3. Readers new to this area should find Chapters 2 and 3 helpful.

Chapter 4 presents the important and useful techniques of fault-tree analysis and common-cause failures. These two topics have been of considerable interest in recent years. Software reliability is discussed in Chapter 5, which describes the models and techniques for assessing and enhancing software reliability. The commonly used models and techniques for studies of mechanical and human reliability are presented in Chapters 6 and 7, respectively. Chapter 8 contains the reliability evaluation techniques and models for networks comprised of devices with two mutually exclusive failure modes. Markov models of repairable components are also described in this chapter.

Chapters 9 to 11 present three significant areas of application, electric power systems, transit systems, and computer systems. These areas of application have attracted a considerable amount of attention and have seen a substantial growth of knowledge. The reader will find a certain commonality of concepts but a great diversity in definitions, models, and methods.

The book is intended primarily for engineers, managers, graduate students, and other professionals interested in the subject of reliability. It can be adopted for a variety of graduate or short professional courses. A general course in reliability engineering would focus on Chapters 2 to 4, 7, 8, and selected portions of the remaining chapters. A course in power systems reliability could be based on Chapters 2, 3, and 9. Chapters 2, 3, and 10 could be used for a course on the reliability of urban transportation systems; and a computer systems reliability course would use Chapters 2, 3, 5, and 11.

Our experience on many projects and environments, teaching, and exposure to several outstanding experts in this area filter through the pages of this book. We would specifically like to thank our former colleagues and fellow professionals at Ontario Hydro and the Ontario Ministry of Transportation and Communications, and our present colleagues at the University of Ottawa and Texas A & M University, as well as many other professionals who, through discussion and writing, have influenced our thinking. We would also like to thank the Department of Electrical Engineering, Texas A & M University, for assistance during the preparation of the manuscript.

We thank our wives, Rosy Dhillon and Gurdeep Singh, for their patience and ever present help during the preparation of the manuscript, and we appreciate the support and encouragement of our parents throughout.

B. S. DHILLON
C. SINGH

Ottawa, Ontario
College Station, Texas
August 1980

Contents