System Reliability Modelling and Evaluation

C. Singh and R. Billinton

Preface

The general area of reliability engineering is extremely wide and in fact
encompasses all aspects of engineering technology. Conventional intuitive
approaches to the evaluation of system adequacy are not sufficient in modern
engineering applications and are gradually being replaced by consistent
quantitative techniques. A basic and common requirement in any quantitative
procedure is the development of a suitable mathematical model to describe the
system. The model may be relatively simple or extremely complex and should
be capable of numerical manipulation. This book is devoted entirely to this area
and deals with the concepts, philosophy and techniques for reliability model
building and evaluation.

The book begins by outlining the elements of reliability planning and discusses
the role of modelling in the reliability program plan. Chapter 2 reviews the basic
probability theory required in subsequent chapters with emphasis on utilization
in system reliability modelling and evaluation. The reader will find that some
previous background in probability mathematics is helpful but not necessary.
Chapter 3 is the key chapter in the book and discusses the concepts of the
frequency balancing approach. These concepts have been used with considerable
success in the reliability analysis of repairable systems. This chapter emphasizes
the calculation of several measures of system reliability. Chapter 4 is concerned
with determining the system reliability characteristics from the statistical
information available on the failure and repair cycles of the constituent
components. Non-maintained systems have been discussed extensively in the
available literature and, therefore, this book is directed towards maintained
systems. The theory and procedures are, however, quite general and can be
equally applied to non-maintained systems. Chapter 5 is devoted to the
utilization of these concepts in the reliability analysis of relatively large
systems and some possible problem areas and solutions are presented. The
available books generally assume constant transition rates and give a cursory
treatment to non-Markovian models. Chapter 6 is devoted to non-Markovian
modelling with special emphasis on the device of stages which is a very practical
approach. The emphasis in the book is on direct analytical methods. A
discussion of system reliability modelling would, however, be incomplete
without a discussion on simulation methods as given in Chapter 7.

The scope of application of the concepts outlined in the book
encompasses virtually all engineering disciplines. The book is therefore
intended as a general treatise and is not aimed at any specific area of application.

C. Singh

R. Billinton

Contents