

Chapter 1

Introduction to Reliability and Its Importance

1.1 Introduction

Reliability engineering is becoming a multidisciplinary science. In earlier days, reliability engineering was considered as equal to applied probability theory and statistics. Nowadays, the reliability research area has been clearly subdivided into smaller entities. The research topics may be divided by the methodology applied; mathematics-based approaches have a long history, especially in reliability analysis of large systems, while physics-based approaches are being introduced, especially in component level studies. New concepts in mathematics are swiftly being introduced to reliability engineering. These include, for example, fuzzy logic [1] and Petri Nets [2]. Physical reliability science has benefited from the increasing computing power that has enabled accurate modeling of complex structures [3–5].

The specialization trend has many desired implications: The accuracy of reliability predictions is getting better [6], and therefore the required safety margins have become smaller. Research in specialized areas also has a tendency to create better results than those achieved when working on a wide research area. One might even state that through specialization reliability is becoming a science instead of being more or less a philosophy.

However, specialization has also some negative impacts. The most obvious one is that as reliability specialists are nowadays focusing on their area of interest only, the interaction between different research topics is getting weaker. In a worst-case scenario, reliability experts cannot understand anymore the neighboring research area problems. Now, it is already evident that component level reliability analysis cannot be fully applied to higher system hierarchy-level reliability considerations. On the other hand, the component-level reliability requirement should originate from system-level requirements.

The present compendium presents a holistic approach of the reliability issues in interconnects, devices, and up to systems in microtechnology. It basically discusses the fundamentals in this field and applications specifically to electronics and MEMS fields.

References

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