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Introduction

The necessity of expertise for tackling the complicated and multidisciplinary issues of reliability and risk analysis has slowly permeated into all engineering applications, with risk analysis and management gaining a relevant role both as a tool in support of plant design and operation, and as an indispensable means for emergency planning in accidental situations.

Failure is an unavoidable phenomenon in all technological products and systems. From the scientific and engineering point of view, the investigation of the uncertain and 'obscure' domain of failures entails the exploration of the functional and physical limits of systems, in an effort to understand how, why and when a device may not function properly. In this respect, the required approach is complementary to the traditional engineering viewpoint which focuses on how and when a machine functions in an optimal way.

Whatever particular failure one is considering, proper control and management of it become essential. Areas of application which involve failure-oriented and failure-driven aspects are Reliability, Availability, Maintainability, Safety (RAMS), Risk, Quality control (QC), Fault Detection and Identification (FDI), security and others. As such, failure analysis presents a strong connotation of multi-disciplinarity which significantly adds to its inherent difficulty. Hence, these failure-oriented disciplines have become more and more important and closely connected so as to require an integrated view. This entails the acquisition of appropriate modeling and analysis tools as complement to the basic and specific engineering knowledge for the technological area of application.

The present lecture notes draw from the specialized literature to address the above issues related to the safety of modern industrial activities and illustrate the classical techniques available for the

evaluation, the management and the control of the associated risks. The motivation behind the effort of editing such notes derives from the need to offer a more organic view of the subject to the students who are attending my courses. In this sense, the contents are limited to the topics I teach in the classroom and are thus certainly not exhaustive of the very extensive subject of reliability and risk analysis and surely lacking in many ways. In any case, I believe that they can be of use in any senior undergraduate university course on the subject or as basis for the initiation of young researchers to the field. To this aim, several numerical examples are provided when appropriate, for ease of understanding.

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