ENGINEERING RELIABILITY

INTRODUCTION

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Outline

CONTACT INFORMATION & GRADING POLICY

- Professor Kwatny, 3-151-A, hkwatny@coe.drexel.edu.
- Course URL: http://www.pages.drexel.edu/ hgk22
- TA: Jean-Etienne Dongmo, Rm: 3-174a, e-mail: jtd32@dexel.edu
- Textbook: System Reliability Theory, Rausand & Høyland, (2^{nd} ed), Wiley, 2004
- Grading Policy
  - Homework: 20%
  - Quiz 1: 25%
  - Quiz 2: 25%
  - Takehome Project: 30%

RELIABILITY ENGINEERING

- Reliability engineering is the discipline of ensuring that a system will function as required over a specified time period when operated and maintained in a specified manner.
- Reliability engineers may also address: maintenance, safety and security.
- The tools of reliability engineers include heavy doses of probability and statistics and specialized tools like *fault trees* and *reliability block diagrams*, as well as traditional engineering tools of modeling and simulation.
- Many organizations and government agencies develop specifications for reliability and specify analysis and test procedures for licensing or acceptance.

BASIC QUESTIONS

Reliability engineers address 3 basic questions:

- When does something fail?
  - failure rate
  - mean time to failure
- Why does it fail?
  - failure modes and effects analysis
  - fault tree analysis
  - reliability block diagrams
  - mean time to failure
- How can the likelihood of failure be reduced?
  - redesign
  - improved manufacturing processes
  - maintenance & inspection
  - training

SOME HISTORY

- 30's Statistical methods for quality control of products
  Determination of air crash probability
- 40's Analysis of German VI missiles
- 50's Failure modes and effects analysis (FMEA)
- 60's Analysis of intercontinental ballistic missiles
  Space research programs
  Fault tree analysis (Minuteman missile)
- 70's Reactor Safety Study (WASH-1400)
  Reliability centered maintenance
- 90's Integration of Reliability, Availability, Maintainability, and Safety (RAMS) into product and process design
- 00's Embedded software systems
  Safety of complex systems

Definitions

3 Related Concepts – Quality, Reliability, Safety

Various standards (e.g., ISO, MIL-) and regulatory agencies (e.g., FAA) provide definitions specific to their domain of interest. The following are generic, working definitions.

- Quality: A product or system is of high quality if
  1. it performs in accordance with specified or implied requirements
  2. the performance is robust with respect to variations in the operating environment and wear or aging
- Reliability: A system is reliable if it provides an (minimally) acceptable level of performance under variable environmental and operational conditions for a specified period of time
- A system is said to fail if it no longer provides an acceptable level of performance.
- Safety: A system is safe if failure does not result in death, injury or an unacceptable level of property loss

Course Objectives

- Understand the basic concepts of quality, reliability & safety
- Compute measures of reliability of products and systems
- Analyze failure data
- Perform a Failure Modes, Effects and Criticality Analysis
- Conduct a Fault Tree Analysis
- Construct and analyze reliability block diagrams
- Identify component importance
- Use redundancy to achieve reliability
- Evaluate the impact of maintenance on reliability

Main Topics

- Basics of Probability & Statistics
- Reliability Models
- Fault Tree Analysis
- Reliability Block Diagrams
- Reliability of Maintained Systems
- Data Analysis & Testing