

EMP 5103 Reliability, Quality and Safety Engineering

Dhillon, B, Reliability, Quality and Safety for Engineers, CRC Press, Boca Raton, Florida, 2005

Marks

Report	30%	Mar 30
Mid Term	30%	Mar 2
Final Exam	40%	Apr 6

Report Format

- Title
 - Summary, it is not an introduction to the report. What is the main highlight of the document? What is contained in the report?
-
1. Introduction – familiarize reader on topic sections.
 2. Main Body – 2.1, 2.2, etc...
 3. Conclusions - future research and studies.
 4. References
 - Books
 1. Gorman, D, Human Reliability, Program Press, New York, 1986.
 - Journal Articles
 2. Williams, R, Engineering Design, Journal of Mechanical Engineering, Vol.10, 1982, pp 10-20.
 - Conference Proceedings
 3. Reiche, H., Reliability Management, Proceedings of the American Society for Quality Control Annual Conference, 1982, pp 10-30.
 - Report
 4. Gorman, S., Technical Management, Report No.1801, 1987, Available from the Department of Mechanical Engineering, University of Ottawa, Ontario, Canada.

Course Outline

1. Reliability background and introductory mathematics.
2. Failure data collection and Sources
3. Static Reliability Evaluation Models
 - Series system
 - Parallel system
 - K-out-n system,
 - series-parallel system,
 - parallel-series system
4. Dynamic Reliability Evaluation Models
 - Exponential distribution
 - Weibull distribution
 - Series, Parallel.
 - K-out-n,
 - series-parallel,
 - parallel-series,
 - Standby
5. Redundancy- Related Topics
6. Reliability Testing
7. Reliability and Maintainability Management
8. Safety Management
9. Robot Reliability and Safety
10. Quality Management
11. Quality Control Charts

1. Reliability Background and Introductory mathematics

Reliability Definition

Reliability is the probability that an item will perform its function adequately for the desired period of time when operated according to specified conditions.

QUALITY

This is the degree to which an item functions or process satisfies the user's and customer's requirements

Safety

This is conservation of human life and its effectiveness and the prevention of damage to items as per specified mission requirements.

History of Reliability

- Power system problems (1930’s)
- World War II (V1 and V2 rockets)
- U.S. Department of Defense (1945-1950)
- Advisory Group on the Reliability of Electronic Equipment (AGREE)—1950
- AGREE report (1957) (it took AGREE 7 years to report on the reliability)

History of Quality Control

- C.N. Frazee of Telephone Laboratories made use of statistical methods in inspection problems—1916
- Walter A. Shewhart developed quality control charts—1924
- Etc...

History of Safety

- Pling, the Elder (AD 23-79) - Historia Naturalis –wearing of protective masks by workers to stop the inhalation of toxic substances
- Miner’s Safety Lamp-Humphrey Davy-18th century
- American Public Health Association—1885 - Occupational Health and Safety
- 1st Text book-Industrial Safety by H. W. Heinrich—1931

Publications

Reliability Publications

- IEEE Transactions on Reliability (1953)
- Microelectronics and Reliability (1962)
- Reliability Engineering and System Safety
- International Journal of Quality and Reliability Management
- Reliability Reviews
- Annual Reliability and Maintainability Symposium (1954)

Safety Publications

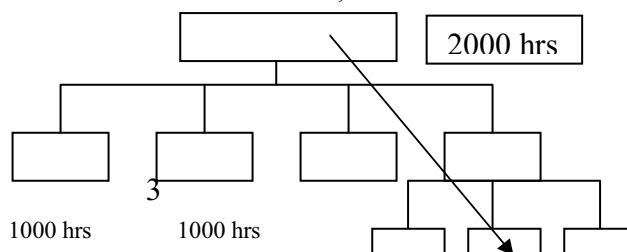
- Journal of Safety Research (USA)
- National Safety Needs (USA)
- System Safety Conferences

Quality Control Publications

American Society for Quality Control (ASQC) –Journals and Conferences

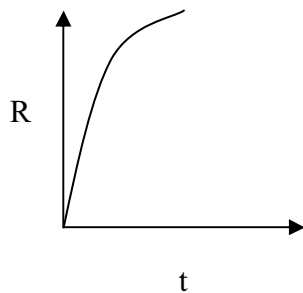
Design Reliability

- Design specification (MTBF-mean time between failure ,MTTR-mean time to repair, Etc)
- Reliability allocation



Allocate top reliability of Arm to subsystems right down to components' level.

- Data collection and Analysis – writing information to databank and retrieving it
- FMEA-Failure Mode and Effect Analysis and FTA- Fault Tree Analysis (methodologies)
- Reliability growth – build a prototype and test it



- Reliability demonstration – takes place at customer facility, performed at the system level and is typically set up as a success test
- Reliability warranty – determine what percentage of the failure population can be covered financially and estimating the time at which this portion of the population will fail
- Failure data feedback – citing the causes/reasons for failure occurrences