Introduction to Reliability Physics & Physics of Failure: Knowledge for Producing Highly Reliable Electronic Products **1 Day Course**

ABSTRACT
Reliability is the ability of a product, system or service to consistently perform as intended (i.e., without disruption or failure) for a specified time period under specified operating conditions, in its life cycle application environment. In electronics the primary approach to achieving reliability has primarily been a statistical approach where "generic" MTBF (average failure rates) for each occurrence of different components types are added up to estimate the MTBF of a complete assembly during the design phase. Followed by multiple round of Design-Build-Test-Fix (DBTF) i.e. trail and error reliability growth testing during product development and qualification.

The Physics-of-Failure (PoF) approach to reliability uses knowledge of a product's expected life-cycle usage and environmental stress load profiles and knowledge of material strength and degradation properties of the architecture and technologies the product is based upon. The objective is to identify and eliminate potential failure mechanisms to prevent operational failures through robust design, strength verses stress analysis and selection of capable manufacturing practices. Reliability assessments based on physics-of-failure methods move reliability growth up into the design process by using scientific basis for estimating product life under actual operating conditions.

This course introduces the classical reliability concepts and relates the concepts to the PoF approach. The information provided in this course will be useful for implementing a Physics-of-Failure methodology for the life cycle of a product. The participants will learn how to develop and migrate to PoF based reliability assessment programs. The course will also teach how to facilitate the introduction of the physics-of-failure methodology among the complete supply chain of the product.

OUTLINE

- Traditional Quality, Reliability & Durability (QRD) Concepts
  - Term and Definitions
  - Fundamental Reliability Concepts The Bath Tub Curve
  - Failure Probability Density Function
  - Hazard Rate
  - Conditional Reliability
  - Mean And Median Time To Failure
- Failure Definitions
- Statistical Distributions in Reliability
  - Weibull
  - Exponential
  - Normal and Lognormal
  - Discrete distributions
  - Failure free operating period
- System Reliability Analysis
  - Reliability Block Diagrams
  - FMEA
  - Basic Reliability Math
    - Series And Parallel Systems
    - Complex Systems
    - Redundant Systems And Limitations
- Reliability Prediction
  - Electrical and Electronic
    - MIL-HDBK 217/Telcordia Approach
    - IEEE 1413 - Reliability Prediction Std

- Reliability Growth
  - During Product Development
    - Test Based Methods
  - During Continuous Production
    - Field Data/Warranty Analysis
    - Return Parts
    - Root Cause Analysis (RCA)
    - Failure Analysis
- Reliability Physics/Physics of Failure
  - Term and Definitions
  - Generic Failure Categories (i.e. Why Thing Break)
    - Errors and Variation
    - Overstress
    - Wear out / Damage Accumulation
- Design for Reliability using PoF
  - Defining product requirements
    - Product life cycle conditions
    - Part and material selection
    - Supply-chain with proper reliability capability maturity
- PoF Based Reliability Assessments
  - Integrating PoF into FMEAs
  - Virtual Validation PoF based Computer Aided Durability Modeling
  - Computer Aided Product Development
- PoF and Testing
  - PoF and Highly Accelerated Testing
    - SAT - Simulation Aided Testing
    - SGT - Simulation Guided Testing
  - Direct QRD Assessment Tests
- Applying PoF to Production Processes
  - 5 Most Common E/E Device Manufacturing/Assembly QRD Issues.
- Conclusions

Who Should Attend?
This course is intended for Electrical and Electronic Design Engineers, Validation/Test Engineers, Quality, Reliability and Product Assurance Personnel, CAE Modeling Analysts and R & D Staff and their supervisors.